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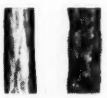

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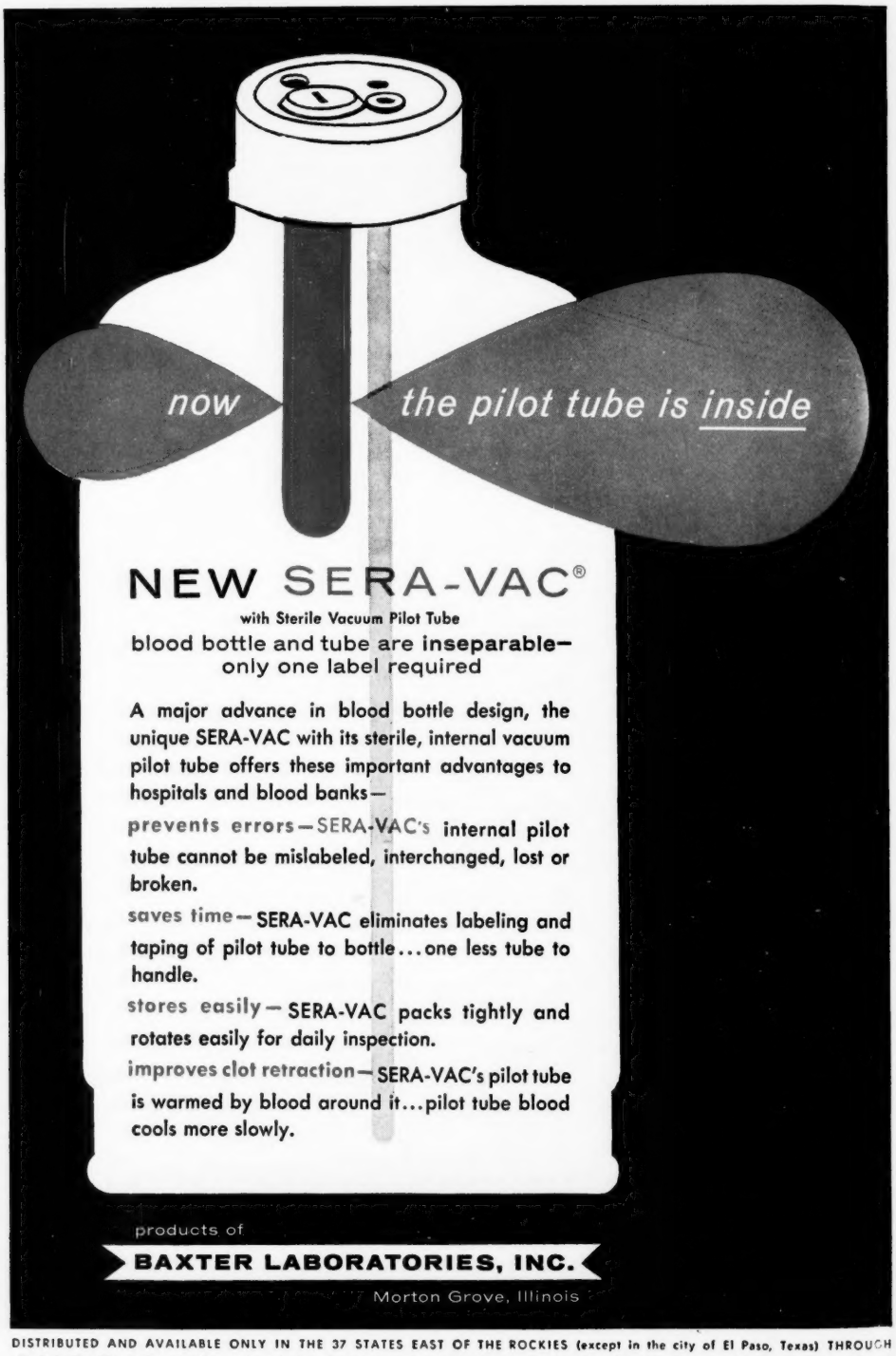

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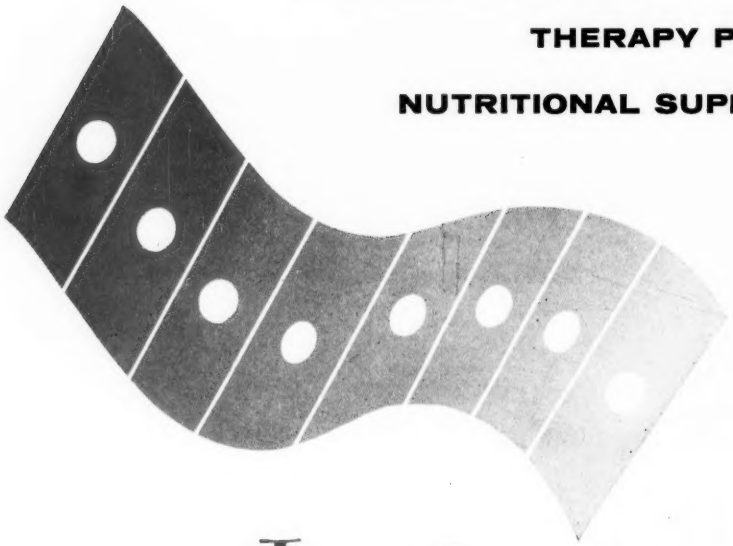

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1. Vilter, Richard W., Am. J. Clin. Nut., 3:72, Jan.-Feb., 1955

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POSTOPERATIVE WOUND INFECTION

R. A. SHOOTER, M.D., GERARD W. TAYLOR, M.S., F.R.C.S.,
GEORGE ELLIS, M.R.C.S., F.F.A.R.C.S., and
SIR JAMES PATERSON ROSS, K.C.V.O., M.S., F.R.C.S., F.A.C.S.(Hon.),
London, England

THE PURPOSE OF THIS ARTICLE is to record the results of measures taken in the Surgical Professorial Unit of St. Bartholomew's Hospital to prevent wound infection following a rise in the incidence of this complication which, there was reason to suspect, was due mainly to air-borne bacteria.

HISTORY

Bacterial infection of wounds after clean surgical operations has disturbed surgeons for many years, and Colebrook has recently reviewed this problem as one aspect of infection acquired in hospital. Despite the widespread prophylactic use of antibiotics and the availability of many forms of chemotherapy, postoperative wound infections still occur and range from the trivial to the lethal. It has even been suggested by Howe that contemporary bacteria cause infection more frequently than did their forebears and it is clear that treatment may become progressively more difficult because the concentrations of antibiotic-resistant staphylococci found in hospitals today are increasing.

From the Department of Bacteriology and the Surgical Professorial Unit, St. Bartholomew's Hospital, London.

Several sources of postoperative infection have been proposed. Wells and Wells (8, 9) drew attention to the presence of pathogenic bacteria in the air; Hart (5, 6) advocated the sterilization of air in operating rooms by ultraviolet light and reported that: "With meticulous operating room asepsis, development of a delicate atraumatic technic, the use of the least irritating suture material, and the elimination of air-borne contamination of the operative wound and sterile supplies by the use of bactericidal radiant energy, wound infection in clean primary incisions may be almost eliminated."

This view was not entirely accepted by Devenish and Miles who described an outbreak of sepsis which they thought was due to a leakage of Staphylococcus aureus, through glove punctures from the skin of a surgeon who proved to be a skin carrier. Because their conclusions differed from those of the American investigators, who indicted the air as the main source of infection, they suggested that: "the improvement, due to a greater nicety of operative technique, may have been wrongly attributed to the elimination of air-borne pathogens."

TABLE I.—INCIDENCE OF WOUND SUPPURATION BEFORE AND AFTER ALTERATION OF THEATER VENTILATION

Month	*Total No. of wounds*	*No. of suppurating wounds*
BEFORE ALTERATION		
July 1954	73	6
August	63	3
September	64	7
October	53	8
November	53	3
December	49	4
January 1955	44	3
February	28	3
Total	427	37
AFTER ALTERATION		
February	20	1*
March	58	1
April	44	1
May	46	0
June	56	0
July	52	0
August	64	1
September	55	0
October	45	0
November	52	1
December	40	0
Total	532	5

*Occurred when input fan was switched off.

More recently Blowers, Mason, Wallace, and Walton described their experience of wound infection in a thoracic surgical unit and stated that, with the exception of 1 case thought to be due to contact infection, they considered that most of it occurred at operation, and that the invading organisms were air-borne.

INCIDENCE OF SEPSIS

The high incidence of wound infection in our patients led to the keeping of a "wound book" in which against every patient's name were recorded: the surgeon, the nature of the operation and its duration, and the solution used to clean the skin. When the stitches were removed, further notes were added to indicate the state of the wound; if infection had occurred its severity and the infecting organisms were recorded. These records have been kept in full since July 1954, and in the course of the following 7 months the monthly percentage of "clean" wounds which suppurated varied between 5 and 11, the average for the period being 9. Detailed figures are given in Table I: potentially infected wounds, in which the wound was obviously contaminated at the time of operation or the incision was made through an infected area, have been excluded.

An investigation into the source of this infection was begun in the autumn of 1954.

BACTERIOLOGIC FINDINGS

Material for bacteriologic investigation consisted of swabs from infected wounds, swabs from noses, hands, arms, and gloves of the surgical team, and floor dust and floor swabs from the wards, passage, and operating room. Air was sampled with a slit sampler as described by Bourdillon, Lidwell, and Schuster in 1948. Staphylococci which coagulated plasma in a tube were described as Staphylococcus pyogenes.

As the infected wounds contained Staphylococcus pyogenes, usually resistant to penicillin, the first step was to request the assistance of R. E. O. Williams of the Public Health Laboratory Service in bacteriophage-typing the staphylococci. This assistance, which was generously given, showed no one surgeon or nurse to be the probable source of infection as the staphylococci from 17 patients' wounds belonged to 11 different bacteriophage types. This evidence was supported by the fact that none of the principal surgeons were nasal or hand carriers. Bacteriophage-typing also showed, in contradistinction to the majority of published reports, a remarkable diversity of staphylococcal types, and in a 4 month period, from the wards, the passage, and the operating room no less than 26 different types were isolated.

While this work was in progress the slit sampler was used to count bacteria in the air of the theater. Samples were collected at the rate of 1 cubic foot a minute, and usually 5 cubic feet were examined at a time. Representative results are given in Figure 1 and are contrasted with 2 counts of outdoor air during the same period (Fig.

2). Each sample of 5 cubic feet was not necessarily taken immediately after the preceding one, because the operator of the machine had other duties. It was rarely possible to correlate the higher peaks with any particular disturbance in the operating room: that the high counts were not due to general activity is, in addition, suggested by Figure 3 when the only person present was the operator of the sampler.

This type of air examination reveals any bacteria which grow on the blood agar medium used at 37 degrees C. Staphylococcus pyogenes was only recovered somewhat irregularly from the theater air, and although on 1 occasion 5 colonies were grown from 7 cubic feet of air, on an average staphylococci were cultured at a rate of 1 colony per cubic foot of air.

From a previous experiment it was known that the ward air also contained pathogenic staphylococci. The method which had been used for sampling was only capable of detecting the presence or absence of staphylococci in 20 cubic feet of air, an amount chosen to represent approximately that breathed by a nurse in half an hour, but, of 6 samples taken in the spring of 1954, all were positive. Subsequent examination with a slit sampler in the winter of 1955–1956, after a period of relative freedom from ward infection, yielded a growth of 113 colonies of Staphylococcus pyogenes from 110 cubic feet of air.

At this stage the bacteriologic evidence could have supported the suspicion that infection began either in the wards or in the operating room, since the same staphylococcal types were recovered from both places and from the passage between. On clinical grounds, however, it seemed likely that entry of bacteria took place during operation, because pyrexia, when it occurred, appeared almost immediately afterward, and most of the infections involved the deep layers of the wound.

It was for this reason that attention was directed to the ventilation of the operating room.

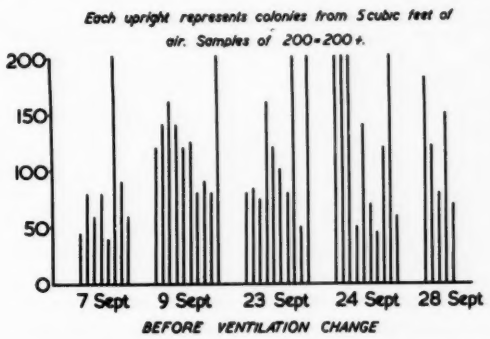

FIG. 1. Counts of bacteria in air samples from the operating room air before ventilation change.

ARRANGEMENT OF WARDS AND OPERATING ROOMS

There are 5 surgical units in this hospital; each occupies a separate floor in the surgical block, is self contained, and consists of male and female surgical wards connected by long passages (90 ft.) with an operating room (Fig. 4). The operating rooms, like the wards, are situated one above the other. The Surgical Professorial Unit occupies the fourth floor.

OPERATING ROOM VENTILATION

In common with the others in the block, the ventilation system of the operating room consists of a supply of filtered outdoor air blown in through an opening near floor

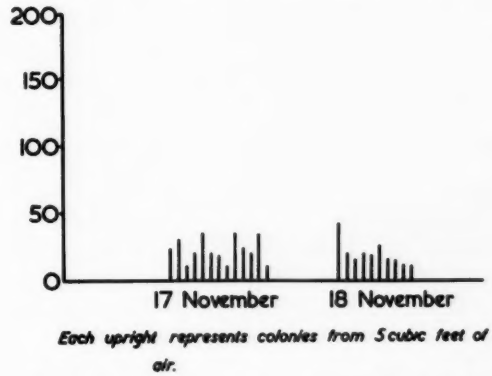

FIG. 2. Counts of bacteria from the outside air in the vicinity of the operating room.

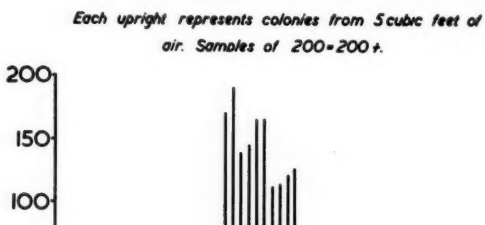

FIG. 3. Counts of bacteria in air samples from the empty operating room.

level by a small fan, and as this air is passed over steam-heated pipes it is used as an auxiliary method of heating. There are also several openings set round the walls through which air is extracted, via ducting, by a fan on the roof. Extraction, although promoted by the fan, still continues when it is not in use because of the upward draft of warm air in the vertical shaft.

Air movements can be followed by watching clouds of titanium chloride smoke, and in this way it was found that however the ventilation arrangements were manipulated, air was constantly sucked under the doors into the operating room from the passage

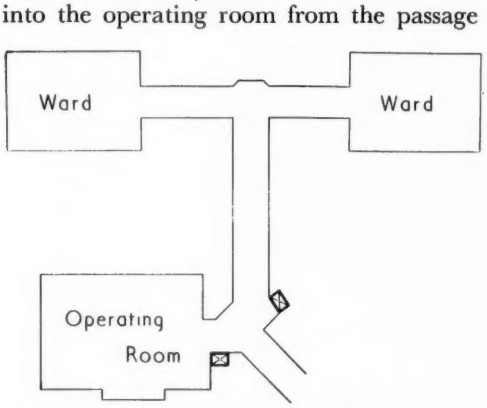

FIG. 4. Plan of the wards and operating room in the Surgical Professorial Unit. The connecting corridor is 90 feet in length.

outside. Furthermore, it seemed probable that some of this air had come from the wards because, although air currents in the passage were disturbed by such things as opening of doors and movements of lifts, down at floor level there was a relatively steady stream of air from the wards to the operating room in spite of the length of the corridor (90 feet).

ALTERATION OF OPERATING ROOM VENTILATION AND ITS EFFECT ON WOUND SEPSIS

From these observations it was decided to try to reverse the flow of air from the passage to the operating room. This could only be achieved by blocking the extract vents, by removing the filters, and by accelerating the small supply fan.

As a result, for the first time air was blown out to, instead of being sucked in from the passage outside. A considerable volume of air was needed to do this, and as the incoming air had to pass through the relatively small opening at floor level it produced a cross-draft which could be felt from one side of the room to the other, and in the center, over the operating table, was strong enough to deflect light cloths. The significance of this draft will be discussed later.

These changes in ventilation were followed by an immediate reduction in the bacteria in the air (Fig. 5), and by a striking fall in the incidence of wound infection. Reference to Table I will show that of the next 500 clean cases only 5 became infected as compared with 37 infections in 427 patients before the ventilation change. Of the 5 which became infected 1 occurred on a particularly cold day when, for fear of chilling the patient, the supply fan was switched off, a procedure which produced reversion to previous levels of air-borne bacteria (Fig. 5, central block). Development of sepsis in the stump of a limb amputated on that day led to perseverance with the new ventilation scheme.

From the outset it was realized that factors other than ventilation could play a part in

the incidence of wound infection. A careful review of operating room technique excluded any obvious breach of accepted ritual, and so that the results of the ventilation change could be assessed with more certainty, no alteration in this technique was made. Iodine, cetavalon, and hibitane were in use for skin cleansing, and the incidence of wound infection before the ventilation change was similar with each of these agents.

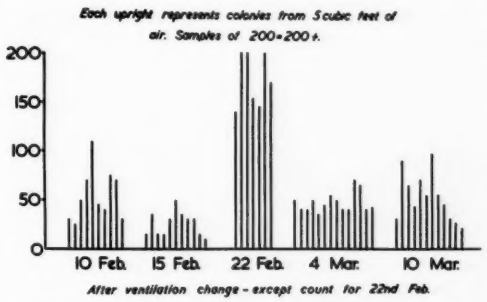

FIG. 5. Counts of bacteria in the operating room air after the ventilation change. On February 22 the ventilation system was restored to its original form for 1 day only.

DISCUSSION

Changes in the ventilation were made because, in the absence of any other obvious source of infection, it seemed likely from the clinical picture, from the multiplicity of staphylococcal types, from the discovery of these types in the wards, the passages, and the operating room, and from the high air counts in this last place that the unsatisfactory nature of the ventilation was allowing bacteria to invade the wounds during operation.

Improvement in the sepsis rate coincided with these changes and, it is believed, was due to them: as particular care had been taken not to alter any other procedure, it is difficult to attribute this improvement to a greater nicety in operative technique.

The most serious objection to this belief is that, although bacteria were present in large numbers in the operating room air, relatively few staphylococci were recovered from it. But information derived from slit-sampler culture plates or from plates exposed close to the operating table suffers from the disadvantage that 1 staphylococcal particle will give rise to only 1 staphylococcal colony, regardless of the size of the particle. If the particles are small they may be of little significance, but if large, may indicate the possibility of heavy wound contamination. At present there is no evidence as to the size of the particles. In addition, although the wound may be small, bacteria need not settle directly on it in order to infect it. Organisms which settle on instruments, towels, swabs, or in bowls of lotion may ultimately find their way into the wound, and the catchment area thus drained may be considerable.

The improvement reported in this paper is in part due to the reversal of air-flow in the operating room, a tardy application of the principles of pressure ventilation which have frequently been described in the past. However, the occurrence of wound infection originating in operating rooms properly ventilated by these principles suggests that another factor may be involved. In 1 such operating room in this hospital, and in others which we have heard of elsewhere, staphylococci have been recovered near the operating table, and wounds have become infected. In a new operating room in this

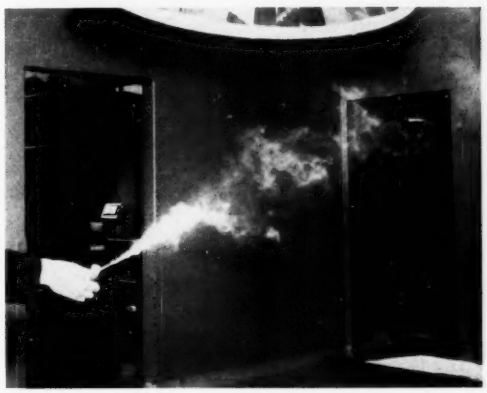

FIG. 6. Demonstration of air currents with titanium chloride smoke. The operating table can just be seen in the lower foreground and the cross draft is being made visible.

hospital the incoming air currents had purposely been directed to cause as little disturbance as possible over the surgical team. Smoke testing showed that the air circulated round the room, leaving a relatively still area over the operating table. From this center staphylococcal particles, which had previously fallen onto the floor from patients' clothes or bedding, and from the noses or clothes of carriers, might drop into the wound.

As we have already described, the ventilation changes in the Surgical Professorial Unit operating room produced a strong cross-draft (Fig. 6). This draft, although it was responsible for considerable turbulence in the theater air, eliminated any still area over the operating table, and may have been partly responsible for the reduction in incidence of wound sepsis.

We believe, therefore, that the ideal operating room ventilation system should provide a slight positive pressure to prevent ingress of bacteria-laden air currents and should also ensure that dust particles are not allowed to settle out over the wound area. If existing ventilation systems require modification these two factors should be kept in mind, and the cross-draft method is one easily applied solution. In new operating rooms the ventilation requirements would be best met by multiple ceiling vents placed over the operating table and delivering air streams obliquely downward toward extract openings placed along the walls at floor level.

Finally, we must emphasize that units faced with an outbreak of wound sepsis should first exclude the many other routes of infection before postulating air-borne contamination.

If, however, the air of the operating room is under suspicion, the provision of what seems to be a correct ventilating system must not be regarded as exonerating it from blame, since the higher temperature inside the operating room as compared with the passages outside may create air currents which convey infection into the room. The use of smoke to check what is actually happening appears to us an essential precaution.

SUMMARY

An inquiry into the cause of wound infection in a surgical unit is described. The clinical facts suggested that infection was occurring in the operating room. A breach in surgical technique was not detected and it seemed that air-borne bacteria were responsible for the high infection rate of clean surgical wounds. Samples of the operating room air showed an abnormally high content of bacteria, and smoke testing of the ventilation showed that contaminated air from the surgical wards was being sucked into the room around the closed doors.

The ventilation was modified so that the powerful input stream of pure air was directed across the operating table and out round the doors. The alterations greatly reduced the bacterial content of the air in the operating room and the wound infection rate fell from 9 to 1 per cent. The improvement was thought to be due to positive pressure ventilation of the operating theater and to avoidance of zones of still air over the operating table.

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BILATERAL ARTERITIS SIMULATING CAROTID BODY TUMORS

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TEMPORAL ARTERITIS, cranial arteritis, and giant cell arteritis are names which have been assigned to a rare inflammatory lesion of the arteries. Hutchinson first described the condition in 1889, and Horton, Magath, and Brown (4, 5) were the first to recognize and describe it as a new clinical and pathologic entity. In 1939, the year of our patient's first admission, there were only about a dozen cases recorded in the literature, but because of increasing recognition and reporting of the lesion, Cardell and Hanley were able to collect 136 cases in 1951. Gilmour recognized the fact that the lesion was not confined to the temporal arteries, and, of the 12 cases out of 27 deaths on which full postmortem reports are available, the internal carotid was involved 6 times and the external or common carotid artery 3 times.

The case presented here is unique in four respects: (1) The right carotid artery was involved first and, after a free interval of 16 years, the left one was similarly afflicted. (2) On both sides the lesion simulated a carotid body tumor. (3) It is the only report of alleviation of symptoms following resection of the carotid artery and provides the only antemortem specimen of a carotid artery so afflicted. (4) It is the only report of the use of radiation therapy for the lesion. This method proved unrewarding. Aside from these aspects there are two other features of unusual interest: (1) The patient, when first seen, was well under the age group in which this type of arteritis is usually found. (2) The lesion on the left side responded favorably to cortisone.

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CASE REPORT

E. B., a 28 year old housewife, was first admitted on March 13, 1939, with a chief complaint of "painful lump in right neck."

She had been well until 9 months prior to this admission when she first became aware of a tender mass in the midportion of the right side of her neck. At first she paid little attention to it because she had previously noted "enlarged glands" in her neck with upper respiratory infections. However, this swelling increased in size and became more tender. For 3 months she had had intermittent shooting pains which radiated into the cheek in front of her right ear. No medical or dental care had influenced the mass or her symptoms.

She had been well except for an abnormal pregnancy with toxemia and pernicious vomiting 4 years ago; this had required a therapeutic abortion.

The vital signs were normal and the general examination was not remarkable. In the right side of the neck, a firm, fixed, tender mass, about 2 by 4 centimeters, was intimately associated with the carotid artery at about the level of its bifurcation. Pulsation was present but appeared to be transmitted and not expansile. No bruit was heard over the mass. Compression of the common carotid below the mass did not alter its size. There was no abnormality on the left side of the neck. The blood pressure was 138/70. On pressing the cervical mass the systolic pressure fell to 128, then rose to 134. On second compression, it fell to 124 and rose to 136. A third attempt caused no change. No difference in blood pressure was found between the two arms. Laboratory findings were: Wassermann, negative; hemoglobin, 13.0 grams; white blood count, 11,000; differential count, polymorphonuclears, 66; lymphocytes, 30; monocytes, 4; eosinophils, 0. The urine was clear.

A diagnosis was made of carotid body tumor on the right side. It was decided to explore the mass and remove it if possible. At the first operation on March 14, 1939, a 3 inch incision was made on the right side of the neck parallel to the skin folds. It was carried down to the carotid sheath where many adhesions were found to be matting the structures together. Over the carotid artery were 2 enlarged lymph nodes which were removed for biopsy. The region of the bifurcation of the carotid was occupied by a firm, smooth mass about 4

centimeters across. There was no cleavage plane between it and the vessels which blended into the mass above and below (Fig. 1). Because the location and consistency of the mass were characteristic of a carotid body tumor it was decided to occlude partially the common carotid artery in preparation for excision. An aluminum band about 6 millimeters wide was placed around the common carotid artery by means of a Halsted band roller and was tightened until most of the pulse was obliterated. The wound was then closed with fine silk. Postoperatively the patient had symptoms of cerebral anemia, i.e., vertigo, headache, and dimness of vision. She would "black out" if she sat up quickly. There was no obvious motor impairment on the left side and the vessels of the eyegrounds pulsated about equally. Her symptoms gradually diminished enough to allow her to be up and about 8 days after operation, though she was dizzy if she changed her position quickly.

At the second operation performed on March 24, 1939, the scar of the previous incision was excised and the wound was reopened with the intention of tightening the band, but the reaction about the aluminum was so great that it seemed hazardous to disturb it. The external carotid artery was doubly ligated and divided. Recovery from this procedure was uneventful.

At the third operation performed on March 29, 1939, a transverse incision was made 2 inches below the previous wound and the common carotid artery was exposed. The vessel was about one-third its normal caliber because of the previous partial obstruction distal to this point. It was desired to occlude it without ligation so that in the event of cerebral ischemia the obstruction could be removed. A Halsted band was used. The wound was sutured with silk. There were dizziness and headache postoperatively but no neurologic disturbance was found to be present. The fundi were symmetrical.

The fourth operation performed on April 2, 1939 was done under general rather than local anesthesia since a more extensive dissection was contemplated. Both wounds were reopened and the flaps were undercut. The common carotid artery was doubly ligated and divided below the bands put on it previously and was dissected out of its bed from below upward. There were dense adhesions, particularly about the band first placed around the vessel. The tumor was freed from the vagus nerve and jugular vein to mobilize it on a pedicle of the internal carotid artery. Here it was necessary to retract the hypoglossal nerve to expose the internal carotid enough to place 2 ligatures upon it. The vessel was divided between these ligatures and the tumor was removed. Both wounds were closed with silk. She did well except for slight deviation of the tongue and salivation, probably as a result of traction on the hypoglossal nerve. There was again some dizziness and her "head felt big" when she was up. She was discharged on April 12, 1939.

Upon pathologic examination the 2 lymph glands showed only hyperplasia. The tumor was yellowish pink on cut section. There was thrombosis, both old and recent, in the vessels. Connective tissue with inflammation in which large multinuclear foreign body giant cells were noted was found in the tissue surrounding the vessels. There were no tumor cells. Thus, this was not a carotid body tumor but a localized inflammatory reaction creating a mass at the bifurcation of the carotid artery.

The patient's progress was very good. She lost practically all of her dizziness, regained her energy and led a normal existence. Eight months after operation she became pregnant and later went through a normal delivery. She was next seen on September 17, 1953, for multiple contusions sustained in an automobile accident.

On August 22, 1955, over 16 years after the removal of the mass on the right side, she was seen for an identical swelling at the level of the bifurcation of the *left* common carotid; this had appeared 4 months earlier. She had had what she considered toothache, though there was swelling of the neck and pain in front of the left ear and in the left temple. The first and third left molars had been extracted, she had received a course of penicillin and had consulted an otolaryngologist before coming to our office.

There was a firm, tender, smooth mass about 3 centimeters in size at the level of the bifurcation of the left carotid artery which had a forceful but not expansile pulsation. Because the right sided mass was inflammatory and not a carotid body tumor, and because of the preauricular pain, the temple was examined carefully. The temporal artery on the left was palpable as a hard, tender cord characteristic of "temporal arteritis." It was decided to try x-ray therapy; 1,500 roentgens were given in 8 treatment days from August 24 to September 6, 1955. By October 31, 1955, there had been no benefit. In fact, the mass was larger and the pain was unrelieved. She was admitted to the hospital November 14, 1955 for biopsy and evaluation for cortisone therapy.

The x-ray examination of the chest was negative, the sedimentation rate was 11, the hemoglobin was 13.2 grams, the white blood count 6,350, and the urine was clear. Blood chemistry determinations were: sodium 136, potassium 4.5, chloride 100, carbon dioxide 25.5. These findings, coupled with a negative physical examination, led to the belief that she was a satisfactory candidate for cortisone therapy. Before starting it, however, a biopsy of the mass was desired to confirm the diagnosis.

On November 15, 1955, a 3 inch incision was made parallel to the skin folds in the left neck over the mass. The dissection was carried down to the common carotid artery below the mass where it was normal and could be easily separated from the jugular vein. On carrying the dissection upward, an inflammatory mass

was encountered which agglutinated all structures in the region of the bifurcation of the carotid. It appeared too hazardous to biopsy this. An enlarged lymph node adjacent to the mass was removed, but it showed only hyperplasia on section.

The patient made an uneventful postoperative recovery. She was given .050 gram of cortisone by mouth every 6 hours starting on November 16, 1955, and was discharged on this medication. On November 24, 1955, after a total dose of 1,300 milligrams (or 1.3 grams), she developed swelling of the face, hands, and ankles, and cortisone was discontinued. It was not begun after the edema subsided because pain had been relieved and the mass was smaller. Five months later she was asymptomatic and the mass, though palpable, was about one-third its former size.

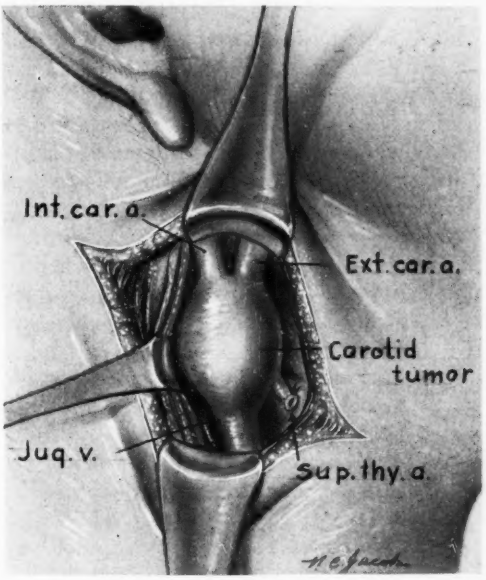

FIG. 1. The tumor at the bifurcation of the right carotid artery as it was seen in 1939. There was no line of cleavage between the tumor and the vessel walls. The enlargement on the left side in 1955 was similar in size and appearance but more adherent to the adjacent tissues.

DISCUSSION

Because of the unusual features of this case, it is perhaps in order to discuss the diagnosis. Kilbourne and Wolff and Meneely and Bigelow have provided some of the characteristics by which the syndrome of giant cell arteritis may be recognized clinically. The typical patient complains of weakness, anorexia, and loss of weight. Anemia and a mild leucocytosis are common although the leucocyte count may be normal. There is no eosinophilia. Prior to the onset of the full-blown picture there is often pain in the teeth, ear, jaw, zygoma, nuchal region, and occiput. Localized findings peculiar to the syndrome are headaches, either unilateral or bilateral, and hot, swollen, tender temporal arteries. About 70 per cent of the patients have an inconstant, low grade fever, and pain on mastication is present in about 50 per cent of the cases. The disease is most often benign and self-limited, resolution taking place in from 1 to 20 months with from 7 to 12 months being the usual time. Death occurs in a little under 20 per cent of the cases, often due to carotid artery involvement. In the benign cases, arteritis is often demonstrable only in the temporal artery.

Because of familiarity with the syndrome of giant cell arteritis, the diagnosis could readily be entertained in 1955 when the patient returned with involvement of the left carotid and temporal arteries. The history of "toothache," pain in front of the left ear and in the left temple, and the finding of a hard, tender temporal artery readily established the diagnosis. In retrospect, her symptoms in 1939 were quite similar, consisting of tenderness of the neck and pain radiating in front of the right ear. The right carotid bifurcation, which was excised at that time, in the belief that a carotid body tumor was being removed, provided histologic evidence of the nature of the lesion.

The age of our patient is unusual, but 3 other cases of giant cell arteritis have been reported in women under 30. The nonspecific symptoms of our patient were quite mild, as they were in Meyers and Lord's case of a 22 year old woman. This suggests that systemic symptoms may be milder in the younger age groups, although the older persons by no means all suffer severely from fever and anorexia. Increased sedimentation rates are common but were normal in a number of the reported cases. Our patient had a mild leucocytosis with her first symptoms but a nor-

mal white count with involvement of the left side. When all the evidence is considered together there can be no doubt that this patient suffered a second bout of giant cell arteritis 16 years after recovery from the first one. The condition most difficult to distinguish pathologically from giant cell arteritis is polyarteritis nodosa. Aside from the microscopic pathology and long history, which are against the latter diagnosis, this patient had no evidence of polyneuritis, kidney involvement, fever, skin changes, eosinophilia, or hypertension.

The various forms of therapy used in an attempt to alleviate this patient's symptoms are of great interest. Resection of the right carotid arteries was followed by relief from pain, as might be expected from previously recorded experiences with resection of the temporal artery. Penicillin, which the patient received prior to her consultation with us in 1955, was of no avail. A similar experience has been reported by Robertson. X-ray therapy (1,500 roentgens in 8 treatments over 2 weeks) was of no benefit. We believe this finding has not been recorded before.

Doret, Roux, and Rywlin reported that cortisone brings about an early remission of symptoms in giant cell arteritis but does not alter the histology of the lesion so quickly. ACHT has also been successful in alleviating pain. We believe that cortisone definitely hastened the recovery of this patient. In a woman who was so dependent on her left carotid artery for an adequate cerebral blood supply it may have stopped the progression of a lesion which could have ended in thrombosis of this vital artery.

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INTUSSUSCEPTION IN ADULTS

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INTUSSUSCEPTION IN THE ADULT is an uncommon condition. Yet it is not rare; figures show that any general hospital providing a hundred or more surgical beds can expect to have 1 case occurring every 12 to 18 months. The majority are secondary, usually to intrinsic tumor, and the condition is not a clear-cut clinical entity, as is the infantile idiopathic type. Consequently, general surgical textbooks make scant reference to the condition in adults. Any large series studied of necessity has to be taken from the surgical literature. Few cases occur in the surgical experience of one individual, and these are usually published as isolated case reports because of their rarity. Therefore, statistical studies on the frequency of occurrence are inaccurate, but from the study of a large number of cases in adults certain features are apparent. Donhauser and Kelly reported 665 cases in adults from the British and American literature from 1900 to 1947, inclusive. The purpose of the present article is to emphasize certain aspects of the history, diagnosis, management, and pathology of the condition in adults with particular reference to the tumor group.

From 1947 to 1952 some 122 further cases have been reported in the British and American literature. These, and the 12 cases now reported, have been used as a basis for the present study. Eleven of the present series represent the experience of this hospital from 1939 to 1954 inclusive. Donhauser and Kelly included jejunogastric, colostomy, and ileostomy intussusceptions in their paper but these have been excluded from our report because it is believed that they are complications of their respective operations and are not true "idiopathic" cases. The lower age limit in the present group is 10 years, i. e., all cases in adolescents and adults over this age are included.

Classified according to etiology, the distribution of the 134 cases fell into the following groups: true idiopathic, 18; due to known cause other than tumor or Meckel's diverticulum, 18; due to Meckel's diverticulum, 7; due to benign tumor, 42; and due to malignant tumor, 49.

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CASE HISTORIES

CASE 1. A male, aged 57 years, was admitted to Royal Halifax Infirmary in June 1952, with recurrent attacks of subacute small bowel obstruction for which laparotomy was advised. He gave a history of 2 previous laparotomies at which easily reducible ileoileal intussusceptions were found in 1943 and 1948. No primary pathologic condition was found on either occasion. In 1948 a mass was palpable in the right iliac fossa before operation. Full investigations in December 1951 and June 1952 were negative.

At operation in June 1952, the terminal ileum and ascending colon were matted with adhesions. The last 45 centimeters of terminal ileum were firmly adherent to the posterior abdominal wall and adjacent loops to each other. There was a small healed ulcer in the duodenum. After a prolonged search, a polypoid tumor, 1 to 2 centimeters in diameter, was felt approximately 30 centimeters from the ileocecal junction, at the apex of a loop of ileum both ends of which were firmly adherent to the posterior abdominal wall. Through a small incision in the ileum the tumor was delivered and excised with its pedicle and a cuff of mucous membrane surrounding the base. The ileum was repaired and ileotransverse colostomy completed the operation. The patient made an uninterrupted recovery.

The tumor was a polyp 1½ centimeters in all diameters with the histologic features of an argentaffin carcinoma, probably more malignant than its counterpart in the appendix.

CASE 2. A male, aged 13 years, gave a story of colicky lower abdominal pain and diarrhea of 2 months' duration when admitted to Hammersmith Hospital. For a few weeks there had been alternating diarrhea and constipation, the excretions being slimy and occasionally streaked with blood. The day before admission the pain increased and the patient vomited once. On examination there was moderate distention

FIG. 1. Barium enema (Case 2) showing obstruction in transverse colon. Note the crescentic edge of the barium shadow.

of the abdomen and a tender, firm, sausage-shaped tumor was found in the epigastrium. Straight roentgenogram of the abdomen showed multiple fluid levels in the lower ileum. Barium enema showed clearly an intussusception reaching nearly to the splenic flexure (Fig. 1).

At operation an ileocecocolic intussusception was found, the apex of which reached to beyond the middle of the transverse colon. This was reduced as far as the cecum manually, but it was not possible to reduce the last 5 centimeters of ileum which had passed through the ileocecal valve. A mass was felt in the cecum about the size of a tangerine orange. Resection of the distal 25 centimeters of ileum, cecum, and 15 centimeters of the ascending colon was carried out with end-to-end anastomosis. The patient made an uninterrupted recovery, but 6 weeks later developed abdominal and pulmonary metastases for which a course of deep x-ray therapy was given. He died a few weeks after the course was completed.

Macroscopically, the cecum contained a sessile, mauve-colored growth the size of a tangerine orange (Fig. 2). There were 2 enlarged lymph glands in the mesentery. Microscopically, the tumor was a malignant neoplasm arising from the submucosa and invading the mucosa and had the histologic features of a reticulum cell sarcoma.

CASE 3. A woman, aged 56 years, was admitted to Hammersmith Hospital on June 9, 1944, giving a history of intermittent subumbilical abdominal pain of 2 weeks' duration. A small melena occurred 2 days before admission and for the 24 hours prior to admission everything eaten had been vomited. On examination the general condition of the patient was good. The abdomen showed moderate subumbilical distention only, no masses being palpable. Rectal examination showed altered blood on the examining finger.

At operation there was clear free fluid, small bowel obstruction, and an ileoileocecal intussusception. The intussusception in this case consisted of the last 20 centimeters of ileum, which was reduced manually. A pedunculated tumor, the size of a walnut, was felt in the ileum opposite a dimple in the bowel wall. The ileum was opened between clamps, the tumor removed with a small area of bowel from which the pedicle was growing and the bowel closed transversely. The patient made an uninterrupted recovery.

Microscopically, the tumor was a fibroma, hemorrhagic, edematous, and partially infarcted.

CASE 4. A nurse, aged 26 years, was admitted to Hammersmith Hospital on December 15, 1942 as an emergency, with a history of 4 hours' severe spasmodic abdominal pain. She gave a past history of intermittent abdominal pain and vomiting of 9 years' duration. Three months, 7 months, and 16 months previously this patient had been admitted and fully investigated, on each occasion with negative results. The only positive finding was of persistent occult blood in the stools for a period of 2 weeks, 3 months previously. On examination the patient was undergoing spasms of pain and a tumor was seen and felt just below and to the right of the umbilicus. On rectal examination coils of distended, tender small bowel were felt in the pouch of Douglas.

At operation a double jejunojejunal intussusception 20 by 6 centimeters was found (Fig. 3a). This was reduced by expression and a tumor 2 by 1.5 by 1 centimeter was found in the antimesenteric wall of the jejunum 25 centimeters from the duodenojejunal flexure. At the edges of the tumor, which merged imperceptibly into the wall of the bowel, there were four groups of telangiectases (Fig. 3c). The liver was normal but there were enlarged glands in the mesentery and adenocarcinoma was suspected. Resection of 45 centimeters of jejunum with the tumor and glands at the apex, and end-to-end anastomosis was therefore completed. The patient made an uninterrupted recovery.

Macroscopically, there was an intramural tumor 2 centimeters in both diameters. Microscopically, this was a leiomyoma of the jejunum.

CASE 5. A female, aged 26 years, gave a history of vomiting, occasional diarrhea, and colicky pains of 8 days' duration when admitted to Hammersmith Hospital as an emergency on November 16, 1949. On examination her temperature was 98.4, pulse 100; she was not acutely ill. A tender mass 8 by 5 cen-ti-

meters was present in the right iliac fossa. She was kept under observation as a case of appendix mass. Four days after admission the mass had disappeared but on the sixth day it reappeared and was considerably larger than on admission.

At operation an irreducible ileocecal intussusception was found. The apex was formed by the base of the appendix and terminal ileum. Through the wall of the cecum an ill-defined tumor was felt and since it was impossible to reduce the intussusception a resection was carried out. The ileum, cecum, and ascending colon were mobilized and brought to the surface through a separate muscle cutting incision in the right loin and excised with a wedge of mesentery which included a few enlarged glands in the ileocecal angle.

The macroscopic specimen consisted of some 7 centimeters of ileum, cecum, and ascending colon, the base of the appendix forming the apex of an intussusception 3½ centimeters long. On the side of the intussusception was an ulcer 2 centimeters in diameter. Microscopically, the ulcer was an anaplastic carcinoma penetrating the muscle coat. Local lymphatics contained tumor cells and the largest lymph gland showed massive metastases. The two emerging limbs were sutured together as a spur and 4 weeks subsequently an extraperitoneal closure of the ileocolostomy was completed.

The patient was admitted 12 months later and again 6 months after this. On both occasions an enteroenterostomy for obstruction due to abdominal secondary deposits was done. She died 18 months after the original operation.

CASE 6. A male, aged 63 years, gave a history of colicky abdominal pain, alternating constipation and diarrhea, and a 9 pound loss of weight during the previous 6 months, when admitted to Hammersmith Hospital on February 14, 1950. On examination the patient was anemic with a palpable, nodular, mobile mass in the right iliac fossa. There were days when this mass was not palpabie. The liver was enlarged 3 fingerbreadths below the costal margin and had a firm smooth edge. Tests for occult blood in the stools were repeatedly negative. Barium enema showed a filling defect in the cecum.

At operation an ileocecal intussusception was found. After manual reduction a nodular tumor was palpable in the wall of the ascending colon just above the ileocecal junction. This had formed the apex of the intussusception. Despite 2 large hepatic metastases palliative right hemicolectomy was carried out. The patient remained free from symptoms and at work until a few weeks before his death from hepatic secondary disease 2 years later.

The excised specimen showed a fungating carcinoma surrounding the ileocecal valve. Section showed a colloid carcinoma which had perforated the wall of the cecum. One of the 4 glands sectioned showed metastases.

FIG. 2. The resected specimen (Case 2). The intussusception is still present, the tumor, a reticulosarcoma, being at the apex of the intussusception.

CASE 7. A female, aged 75 years, gave a history of diarrhea, abdominal pain, and vomiting of 5 weeks' duration when admitted to Hammersmith Hospital on October 15, 1943. On examination the patient was mildly dehydrated and there were 2 visible and palpable masses in the abdomen (Fig. 4). Barium enema passed up to a point between the middle and distal third of the transverse colon, where it was blocked. The appearance of cupping suggested intussusception. Occult blood was present in the stools on 1 occasion.

At operation a partially reducible intussusception of the colon was found, and a hard tumor felt at its apex in the transverse colon (Fig. 5). A Lahey type of right hemicolectomy was performed. The patient made a good immediate recovery, having normal bowel actions from the third day, but 3 weeks later she developed bronchopneumonia and died.

Macroscopically, the excised specimen was a colocolic intussusception at the apex of which was a tumor. Microscopically, this was an infected mucoid adenocarcinoma of the colon.

CASE 8. A female, aged 16 years, admitted to Hammersmith Hospital on May 1, 1941, gave a history of attacks of colicky abdominal pain of 3 months' duration. Four days previously she had been wakened by a violent generalized abdominal pain and during the ensuing 3 days had persistent vomiting and constipation. On examination her temperature was 100, pulse 110. She had marked fetor oris with dry, furred tongue. There was diffuse soft distention in the abdomen with generalized tenderness particularly marked in the right iliac fossa.

At operation the appendix and pelvic organs were normal but the terminal ileus was inflamed and studded with small shallow ulcers. A mass was felt in the cecum. The cecum was opened and the mass, projecting into the lumen, was found to be an intussusception of the last 3 centimeters of the terminal ileum which had passed through the ileocecal valve. The

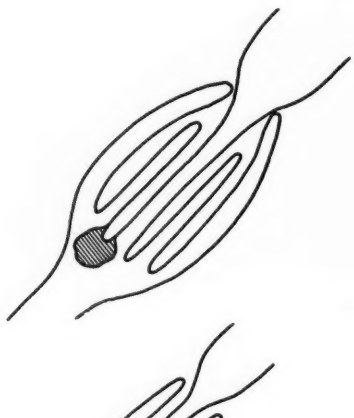

FIG. 3. Diagrammatic representation of findings at operation (Case 4). Double jejunojejunal intussusception due to leiomyoma.

intussusception was irreducible and in view of the small bowel obstruction an ileotransverse colostomy in continuity was performed. A portion of the mucosa of the terminal ileum was removed for biopsy and the cecum closed. Apart from pyrexia, which persisted for a few days after transfer to a fever hospital, the patient made an uninterrupted recovery.

The specimen showed lymphadenoid hyperplasia and a few giant cell systems not typical of either Crohn's disease or tuberculosis. Culture of a stool taken 10 days after operation yielded a pure growth of Bacillus paratyphosus. Blood agglutination against Bacillus paratyphosus antigen gave a positive result in a dilution of 1 to 800.

CASE 9. A male, aged 56 years, gave a past history of gastric ulcer for which Polya type gastrectomy had been performed 7 years previously, when he was admitted to Hammersmith Hospital on March 4, 1953 with symptoms of subacute intestinal obstruction. Seven weeks previously the patient had had an attack of colicky lower abdominal pain and vomiting, which persisted in mild degree until admission. Bowels had been costive for 6 weeks, and absolute constipation present for 4 days. No blood was observed in the stools. On examination the patient was in good general condition, dehydration being minimal. The abdomen was generally tender with some rebound tenderness in the right iliac fossa. Visible peristalsis was observed. A straight x-ray film of the abdomen showed a distended small bowel with fluid levels in the pelvic coils.

At operation dilated coils of small bowel were encountered leading to a mass in the right iliac fossa. On delivery this mass was found to be an ileoileal intussusception, only partially reducible. Resection of the irreducible part of the intussusception with end-to-end anastomosis, and appendicectomy were carried out. The patient made an uninterrupted recovery.

Macroscopically, the resected ileum showed marked ulceration both in intussusception and intussuscipiens, the latter showing evidence of perforation and having a suppurative exudate on its serous surface. Microscopically, the submucosa of both showed active granulation tissue. There was no indication of a pre-existing lesion of the ileum but there was sufficient nonspecific inflammatory change present to make it clear that this intussusception had been present for some weeks.

No cause was found in this case and it was therefore considered idiopathic. It is, however, possible that a polyp had been present but had sloughed away and that the edema had maintained the irreducible intussusception.

CASE 10. A frail female, aged 77 years, gave a 6 weeks' history of painful defecation and "something coming down at stool," when admitted to Hammersmith Hospital on May 6, 1949. Five days prior to admission the mass came down and could not be returned manually. On admission, there was a tumor presenting through the anus very like a cervix uteri. The index finger could be passed up and round the tumor to a distance of 8 centimeters. The tumor was manually reduced and the buttocks strapped. The following day the position was that of an incompletely reduced intussusception. An unsuccessful attempt to complete the reduction was made by running in barium from a height of 5 feet. Forty-eight hours after admission the intussusception was still incompletely reduced and obstruction had become absolute.

At operation under general anesthesia the pelvic colon, full of hard scybala, was seen to be entering the rectum. Following an unsuccessful attempt to reduce the intussusception by pressure from below and gentle traction from above, a left inguinal colostomy was performed. Progress was satisfactory for 3 weeks despite retention of urine which required an indwelling catheter, but bronchopneumonia supervened and the patient died on the twenty-third postoperative day.

The specimen consisted of a sigmoidorectal intussusception with no primary disease.

CASE 11. A woman of 57 years, when admitted to Hammersmith Hospital on October 27, 1941, gave a history of diarrhea for 1 week, and on the day before admission passing blood per rectum and feeling "something coming down at stool." On examination there was slight lower abdominal distention and a palpable descending colon. Protruding from the anus was a sigmoidorectal intussusception at the apex of which was a villous tumor (Fig. 6).

On October 28, 1941 examination under anesthesia confirmed intussusception. Sigmoidoscopy, through the apex, confirmed the absence of further tumors and the intussuscepted bowel was, therefore, removed and anastomosis with serial mattress sutures was completed.

Macroscopically, there were 2 tumors, one small and apparently benign, the other much larger and appearing malignant. This finding was confirmed microscopically, the report on the larger tumor stating "there are numerous mitoses and the appearance is that of malignant metaplasia."

In view of this report further resection of 24 centimeters of sigmoid colon and mesentry was carried out from above 3 weeks later. The patient made an uninterrupted recovery, but was subsequently readmitted for malignant lesions in the rectum in September 1942, and December 1948, the latter admission culminating in a synchronous combined abdominoperineal resection in January 1949. Convalescence was prolonged owing to persistent retention of urine. The patient was known to be alive and well in May 1953. (A photograph of this patient's intussusception on admission to hospital was published by M. R. Ewing in his Hunterian lecture on villous tumors of the rectum.)

CASE 12. A woman of 61 years, when admitted to Hammersmith Hospital on August 6, 1954, complained of recurrent abdominal pain and loose bowel actions for 4 months. There was no rectal bleeding. On examination there were increased bowel sounds but little distention and a mass was palpable to the right of the umbilicus. This mass was not palpable the day after admission but reappeared subsequently. Occult blood was present in the stools and x-ray examination showed a filling defect in the cecum with a "coiled spring" appearance in the ascending colon (Fig. 7)

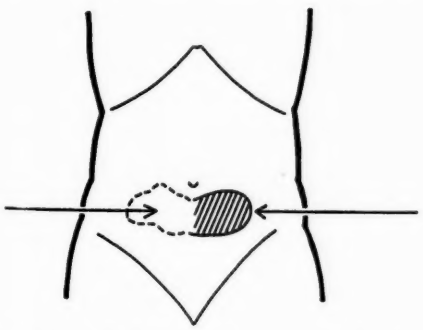

FIG. 4. Case 7. Colocolic intussusception due to carcinoma. Note position of transverse colon in hypogastrium. Arrow at left indicates soft mass which was felt to relax and contract during spasms of pain. Arrow at right indicates hard mass dull to percussion.

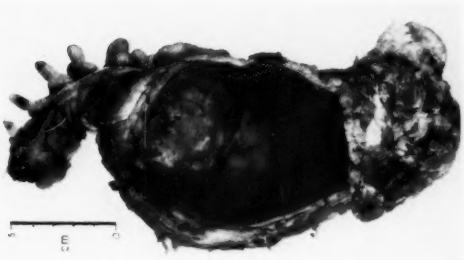

FIG. 5. The resected specimen (Case 7).

At operation an ileocolic intussusception, partially reduced by the barium enema, was found. A primary right hemicolectomy with end-to-end anastomosis was carried out. The patient made an uninterrupted recovery and is still alive and well.

Macroscopically, the specimen was an ileocolic intussusception at the apex of which was a polypoid carcinoma almost encircling the ileocecal valve. Microscopically the tumor was a well differentiated mucin-secreting adenocarcinoma.

ETIOLOGY

The emergency surgeon will be responsible for treatment of intussusception in the majority of cases, and a study of each group may help him in the diagnosis and also as to the decision that he should make at operation.

True idiopathic etiology. It is not the purpose here to discuss the manifold theories of etiology in this group though many of these are of interest. Abnormalities of diet, acid base disturbances, minor trauma, and many other factors probably play a part. The general consensus is that there are two primary factors in the production of intussusception, namely, a ring of excessive relaxation in the distal segment and a wave of contraction in the proximal segment. The latter occurs as a result of any one of many different stimuli, including operative trauma. Chaffin reported a series of 18 cases occurring in pregnancy in the postpartum period of which all but 2 were idiopathic. This

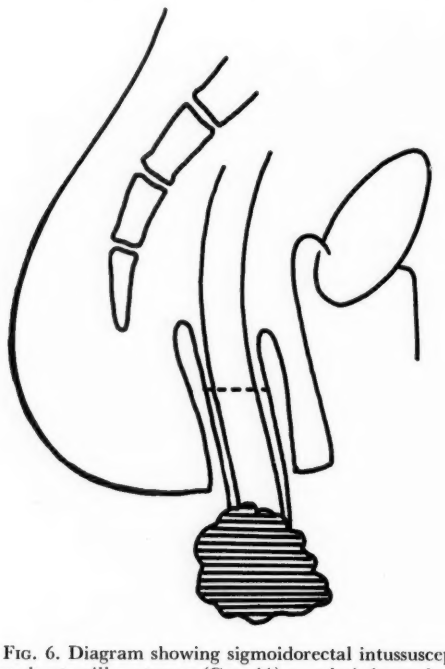

FIG. 6. Diagram showing sigmoidorectal intussusception due to villous tumor (Case 11) on admission to hospital. Dotted line shows level of primary resection.

observation suggests that even the presence of an extrinsic abdominal tumor may be the stimulus provoking invagination. Dempster reports 5 ileocecal intussusceptions in 18 dogs in which a kidney transplant into the right iliac fossa had been carried out. Between 1947 and 1952 the only reported idiopathic case in the enteric and ileocecal groups was that of Jackson; it occurred on the seventh day of the puerperium in a Chinese woman.

Arenson, in an interesting paper, reports 9 cases (8 in children, 2 to 8 years old, and 1 in an adult) of enteric intussusception in which the invagination was demonstrated roentgenographically but all recovered without operative treatment. The histories of these cases contained references to many previous attacks of "severe indigestion" with spontaneous recovery. He claims that these attacks were almost certainly unrecognized intussusceptions and that they were due to intestinal allergy. Various items of food were responsible, notably milk, and all 9 patients had remained free of attacks since treatment with antihistamine drugs. Golden has shown that of all the staple foods milk causes more hypertonic segmentation and hypermotility than any other.

A study of Table I shows that, as in infants, there is a marked preponderance of males in the enteric and ileocecal groups. The sigmoidorectal group, on the other hand, were all females. This observation suggests that constipation, more common in females, is a possible etiologic factor in this group. It may be that sigmoidorectal invagination is really a form of prolapse rather than a true intussusception.

Causes other than tumor or Meckel's diverticulum. Causes in the 18 cases in this group are classified as follows: trauma, 3; strangulation of cecal haustrum, 1; hypertrophied ileocecal valve, 1; diverticulitis of cecum, 1; mucocele of appendix, 3; foreign body (including Miller-Abbott tube), 2; chronic appendicitis, 2; acute colitis, 2; diverticulitis of sigmoid, 1; typhoid, 1; and chronic nonspecific cecal ulcer, 1.

Trauma.—In all the larger series published on intussusception in the adult a number of cases are directly attributable to trauma. Leichtenstein found 26 in 376 cases (8 per cent), and 14 of these following a direct blow on the abdomen, the remaining 12 occurring during severe physical exertion.

TABLE I.—IDIOPATHIC INTUSSUSCEPTIONS FROM 1947 TO 1952

	Enteric	*Ileocecal**	*Appendicocecal*	*Sigmoidorectal*	*Total*
No.	8	3	1	4	16
Sex					
Male	7	2	—	—	9
Female	—	1	1	4	6
Average age, yrs.	44.7†	—	—	57.5	44
Abdominal tumor	—	2	1	1	4‡
Blood per rectum	1	—	—	3	4
History					
Under 48 hrs.	3	1	—	—	4
Under 3 weeks	1	2	—	2	5
1 to 6 mos.	2	—	1	1	4
Years	1	—	—	1	2

There were no gastroduodenal or colocolic intussusceptions in this group.

*The term "ileocecal" also includes ileocolic and (probably 1) cecocolic types because these are not clearly differentiated in the published cases. Two of the published cases have been excluded because of inferior documentation.

†Includes ileocecal.

‡In all 4 of these cases the intussusception was palpable and visible per rectum.

During the height of a "fight or fright" reaction intestinal activity is minimal, and if the abdominal wall is subjected to a severe blow at the same time it is reasonable to suggest that the two primary factors, namely, a relaxation ring and a contraction ring, are reproduced, thus producing invagination. Of the 3 cases in this group, 1 was due to a gunshot wound, 1 to surgical trauma, and 1 to a direct blow on the abdomen, the last reported by Cook. The first of these reported by Falor in 1948 occurred in a man wounded in battle with a small perforation of the sigmoid colon. At operation multiple direct and retrograde enteric intussusceptions were found. These reduced easily and showed no tendency to recur. This appears to be the only case reported in a battle casualty of World War II, and it is to be noted that the invaginations in this case were an incidental and unexpected finding. Falor considered this fact extraordinary in view of the large number of abdominal gunshot wounds sustained during 1939 to 1945. It must be remembered, however, that by the time these patients reached the operating table most, if not all, would have been in a state of paralytic ileus, which condition would favor spontaneous reduction, even if the initial injury had produced invagination. The second case, reported by Grant and Bowden, is something of a surgical curiosity. After a total gastrectomy and partial pancreatectomy for carcinoma, the patient spontaneously passed 10 centimeters of necrotic large bowel on the tenth postoperative day. During the gastrectomy the mesocolon was partially resected and then closed around the retrocolic segment of jejunum used for the anastomosis. The authors attribute this intussusception to the devitalized segment of transverse colon produced by the clearance of the mesocolon.

Chronic nonspecific ulcer of the cecum.—In the older literature on adult intussusception this condition seems to have been fairly common. It was regarded as a cause of invagination and considered to be probably dysenteric in origin. Two cases recently published put forward a different theory of etiology. Roberts suggests that strangulation of a cecal haustrum, of which there was evidence in his case, can be the starting point of ileocecal invagination. Pressure of the apex of the invagination, formed by the ileocecal valve, on the damaged cecal wall, would assist ulceration particularly in the cecum where the bowel contents are bacterially contaminated. Roberts suggests that chronic nonspecific ulcer of the cecum may, therefore, be a result of invagination and not a cause. The case reported by Sangster in which a right colectomy was performed for what appeared to be a carcinomatous ulcer in the cecum associated with invagination, but which proved on microscopy to be benign, falls into the same category. Autoreduction is known to occur in invagination, and this phenomenon would explain the occurrence of ulceration in the cecum, even in the absence of invagination at the time of operation.

FIG. 7. Barium enema (Case 12) showing "coiled spring" appearance in ascending colon. Partially reduced intussusception due to carcinoma.

Typhoid.—In countries where typhoid is still prevalent, invagination due to this cause should be kept in mind. It seems to occur most commonly in the fourth and fifth weeks of the disease and it is interesting to note that the patient described in Case 7 in this series had been unwell for some weeks before admission. Her story suggested that in her case the disease was in its later stages for she recovered rapidly within a few days of transfer to a fever hospital. This case also illustrates that, if for some reason resection is contraindicated, it is permissible in these special circumstances merely to defunction the bowel containing the intussusception.

Meckel's diverticulum. Meckel's diverticulum is demonstrated in approximately 1.5 per cent of all necropsies. Harkins (see Fig. 8) in an extensive review of 111 cases showed that certain characteristic features were associated with this type of invagination. The patient is usually a boy, with a previous history of abdominal crises sometimes since early childhood. Melena is a common feature and the type of obstruction is usually subacute. The classical contractile tumor is more common than in other types of intussusception. The original invagination in these cases is lateral and, therefore, the intestinal lumen is incompletely obstructed for a longer period than usual. This would account for the fact that the final history of acute illness is usually of 3 to 4 days' duration compared with the catastrophic suddenness of the infantile type. This factor may lead to delay in operative treatment which, especially in the younger patient, will seriously affect the prognosis. In the first two decades Meckel's diverticulum is responsible for over 90 per cent of intussusceptions in which a cause is found. From the age of 20 years onward the number due to this cause decreases until in patients over 40 it is responsible for only 4 to 5 per cent of cases.

The tumor group. It is usually stated that the majority of intussusceptions in adults are due to benign tumors. Certainly in Donhauser and Kelly's series, the benign tumor cases were twice as frequent as the malignant. In the present series 36.6 per cent were due to malignant tumors and 31.3 per cent due to benign. Several factors may account for this fact. Firstly, Donhauser's paper covers the period from 1900 to 1947. The increased expectation of life in this country and in the United States since the early 1900's will account for an over-all increase in the number reaching the malignant age groups. Secondly, certain tumors, such as carcinoid, have in the past been regarded as benign though it is now recognized that they should be considered as malignant when they occur outside the appendix. Thirdly, intussusceptions of colonic neoplasms, much more commonly malignant than small bowel tumors, do not present in such a dramatic way and are, therefore, less likely to be reported. It is probable that secondary colonic intussusception is much more common than the literature suggests. It would seem, therefore, that secondary intussusception is more often due to a malignant tumor now than in the past. For obvious reasons, it is important to appreciate this tendency.

The average age of 27 patients in the benign group, in which the age was stated, was 40 years. The average age of the 23 patients in the malignant group, in which the age was stated, was 53 years. A malignant etiology should, therefore, be suspected in the patient over 50, but the occasional adolescent (Case 2) or young adult will have a malignancy, often of anaplastic type.

Striking differences in the total duration of the condition were found when the two groups were compared. The types of history also differed considerably. In the group of benign tumors, the average duration of the symptoms in 30 patients was 15 months; in 2 it was between 6 and 10 days; and in only 3 the onset was of catastrophic suddenness, only a few hours before admission. The majority of patients gave a story of recurring abdominal crises of varying frequency and severity, culminating in the final obstruction for which surgery was required. The duration of the symptoms of the final illness

varied between 24 and 72 hours. In between the attacks of abdominal pain the patients were well, though about half of them had lost weight. Many of them found that by exercising discretion over their diet they could decrease the number of "incidents" and attributed their loss of weight to this procedure. In the group of malignant lesions, the average duration of the symptoms in 23 patients was only 10 weeks. In only 2 was the history longer than 12 months. Of these, one, a man with multiple polyps of which 1, in the cecum, was malignant, admitted symptoms for the previous 5 years. The other was a man of 49 with a carcinoid of the ileum, whose symptoms dated back for 6 years. Thus the only 2 with a long history had good reason to have symptoms before the malignancy really established itself. In the second case, spread to the lymphatics had occurred, but there were no metastases in the liver.

Unlike the infantile type, only one-third of the patients in both these groups gave a history of rectal bleeding or were known to have had blood in the stools. There was little difference in numbers between the benign and malignant groups.

In the benign group, there was a history mainly of incidents of abdominal colic between which the patients were well; but in the malignant group either the patient or his relatives had noticed a steady deterioration in the 3 or 4 months prior to the final incident.

DIAGNOSIS

The diagnosis is rarely made before operation in an adult patient. Being an unusual condition it is not suspected. If a tumor is felt, a note is made of its site and characteristics, but the key physical sign is the contractile, or "disappearing" tumor which is only detected by frequent observation. The importance of making the diagnosis lies in the fact that in its fully developed form intussusception is a strangulation obstruction, and conservative measures are contraindicated other than as a preoperative measure.

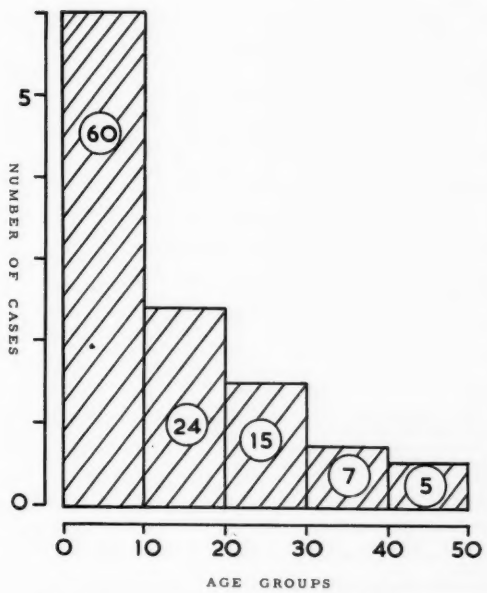

FIG. 8. Graph showing age distribution of intussusception due to Meckel's diverticulum. The figures are taken from Harkins' review of 111 cases (13); 75 per cent of these occur in the first 2 decades.

In the 134 cases now reviewed a preoperative diagnosis has been made on one or more of four findings: (1) observation of a contractile or "disappearing" tumor (Cases 4, 8, and 10); (2) a positive barium enema (Cases 2 and 12); (3) when the condition has been known to be present previously in the same patient (Case 1); (4) when an intussusception was felt per rectum (Cases 10 and 11).

Only a small percentage of patients with secondary intussusceptions are too ill on admission for a dilute barium enema examination. A straight film of the abdomen is always worth while and, as Burge has indicated, on occasion it is possible to see the outline of the apex of the intussusception without the use of contrast medium. Barium enema may reveal no more than the level of obstruction, but there are 3 signs which are diagnostic: (1) the "coiled spring" appearance (Fig. 7); (2) the crescentic edge (Fig. 1); and (3) the "pitchfork" sign described by

Keeley in 1950. Although it has not been the custom in this hospital to carry out barium enemas on emergency cases as a routine, there is a good deal to be said in favor of this examination in the patient with obstruction. The two arguments against the use of barium are firstly, the danger of perforation, and secondly, the difficulties produced at operation by the presence of a loaded colon.

Cases 1 and 4 in the present series illustrate the difficulty in the diagnosis of small bowel tumors. In both these patients at one time a considerable functional element in the symptoms was thought to be present, and it is possible that in Case 1 the original intussusceptions, believed at the time to be idiopathic, were due to the carcinoid discovered 12 years later.

PATHOLOGY

The distribution of 410 tumors which have caused intussusception is shown in Table II. These figures include 319 cases of Donhauser's series, 82 reported between 1948 and 1952, and the 9 tumor intussusceptions reported here. Only those in which a firm pathologic diagnosis has been made have been included. It can be seen, that 244 of the 410 have occurred in the ileum and cecum, and that the largest individual group in any particular intestinal segment consists of the 123 benign tumors occurring in the ileum. However, it should be noticed that 49 of the total 172 ileal tumors were malignant. A further point of interest is the almost equal total incidence of carcinomas and benign polyps in their respective groups.

Of the 13 cases due to intestinal polyps reported between 1948 and 1952, 6 were multiple; and of these, 3 occurred in different segments of the intestine; e.g., stomach and lower ileum, ileum, and ascending colon. This point is stressed because the multiplicity of the primary lesion may easily be overlooked at the emergency operation. This oversight may cause confusion in the postoperative period because of further symptoms and has been responsible for inadequate surgery in a number of reported cases. Furthermore, the tendency to malignant change in cases of multiple polyposis should not be overlooked.

Carcinoid tumors, about which there has been considerable controversy in the past, fall into this group. Bowers and Cheek state that 33 per cent of all surgically removed small intestinal tumors are carcinoid and that because of their slow growth the prognosis is good, even if there is lymphatic and glandular invasion. In 240 cases the average age was extremely constant at 57 (see Case 1), and patients present a constant type of history of loss of weight, anemia, and recurrent obstructive attacks. In their opinion, if a carcinoid is polypoid it is nearly always benign (Case 1) but the majority show a tendency microscopically to transgress the muscular wall, and, therefore, should be treated by radical resection.

Usually the tumor is at the apex of the intussusception, but, as reported by Wardill, it may be situated in the bowel proximal to the apex. Therefore, secondary intussusception, although most commonly due to traction of a pedunculated polyp on the bowel wall, can be produced by other mechanisms (Case 4).

Cattell has classified tumors of the small bowel into two groups, those which grow toward the lumen and those which grow toward the mesentery. Most of the first group are benign, the latter malignant. Thus for mechanical reasons alone a higher incidence of intussusception is to be expected in the benign group. As Cattell points out, the tendency for the malignant group to grow toward the mesentery accounts for the poor (5 per cent) 5 year survival rate following resection in malignant small bowel tumors.

TREATMENT OF SECONDARY INTUSSUSCEPTION

Approximately 85 per cent of intussusceptions in adults are secondary to tumor. Secondary intussusception is a form of strangulation obstruction in which the treatment of the underlying tumor often has to be undertaken at the same operation. It is not

TABLE II.—TUMORS CAUSING INTUSSUSCEPTIONS

	Stomach	*Duodenum*	*Jejunum*	*Ileum*	*Appendix*	*Cecum*	*Ascending colon*	*Colon*	*Sigmoid*	*Rectum*	*Total*
BENIGN											
Papilloma, Adenoma } Polyp	10	5	24	56	1	5		3	3		107
Lipoma	1		3	29	18	19		5			75
Fibroma			3	24	2			2			31
Leiomyoma	2		4	7							13
Endometriosis				2	1						3
Myoma				2							2
Hemangioma			2	2							4
Carcinoid*			1	1	1						3
Neurofibroma			1								1
Totals	13	5	38	123	23	24		10	3		239
MALIGNANT											
Carcinoma	3		7	10		42	2	31	10	10	115
Sarcoma			3	22		4		1			30
Carcinoid			1	7	2	1					11
Melanoma			1	3							4
Lymphoblastoma † and lymphosarcoma				5	1	1					7
Malignant polyp				2				2			4
Totals	3		12	49	3	48	2	34	10	10	171

*This refers to "carcinoids" which were microscopically benign and includes 1 argentaffinoma.
†The term lymphoblastoma is used in the American literature and lymphosarcoma in the British literature.

usually an urgent emergency, and as Hutchinson pointed out in 1893 "the older the patient the slower in all probability the symptoms, the longer the period during which it is permissible to effect relief by operation. Thus in adults an intussusception may be protracted over weeks or even months. The conditions present even after a very long interval may still be such as to permit of a successful operation."

Every patient should be treated on the merits of his or her case, but from the study of the literature certain generalizations can be made. For practical purposes the procedure to be adopted for a secondary intussusception, over 80 per cent of which are in the enteric or ileocecal[1] groups, will be one of three: in the upper ileum and jejunum, resection for the irreducible intussusception, or, if reducible, transmural removal of the tumor if macroscopically benign; resection for the doubtful or frankly malignant; in the lower ileum and cecum, a primary right hemicolectomy of the Lahey type for the irreducible intussusception or those that are seen to be frankly malignant after reduction.

[1]The term ileocecal is used here to include ileocecal and ileocolic intussusceptions.

The problem case is the reducible intussusception in which the underlying pathology is in the cecum and is doubtful. In these circumstances a transcecal inspection of the tumor is permissible and an ileotransverse colostomy not in continuity is probably the safest course. A recurrence of the intussusception in the defunctioned bowel is extremely rare, no case being reported in the literature studied.

1. In general it can be stated that staged operations increase the morbidity considerably. For the irreducible ileocecal intussusception, a primary right hemicolectomy, even in the presence of obstruction, appears to carry less over-all risk than a staged procedure.

2. Transileal or transcecal removal of a polyp or other benign tumor following reduction has not been followed by complications in reported cases. This procedure may obviate extensive resection and would, therefore, seem to have a place in treatment. Naturally this applies to cases in which the tumor is macroscopically benign.

3. Anatomic considerations will limit the width of resection possible in the upper ileum and jejunum. Malignant tumors oc-

curring in this segment are rare and, apart from carcinoid, highly malignant, and therefore carry a bad prognosis however wide the resection.

4. Finally, a thorough search should always be made for polyps in other segments of the bowel when a polyp is the primary cause of intussusception.

SUMMARY

Twelve cases of intussusception in adults are reported. A review of 122 cases reported in the British and American literature of 1948 to 1952 is presented and an analysis of the history, diagnosis, pathology, and management of the condition is made, with particular reference to secondary intussusception.

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A MORE AGGRESSIVE APPROACH TOWARD THE RESTORATION OF BLOOD FLOW IN ACUTE ARTERIAL INSUFFICIENCY

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RECONSTRUCTIVE SURGICAL METHODS and rationale, currently applied to problems of chronic arterial insufficiency, should be more vigorously used in the treatment of acute arterial insufficiency.

Treatment of *chronic* lower extremity ischemia in the arteriosclerotic by the restoration of arterial continuity by thromboendarteriectomy or vascular graft is possible in a significant percentage of cases and is becoming accepted as a reasonable and safe procedure. Because of the resulting increase in the degree of symptomatic relief possible in this group of patients, minor symptoms of arterial insufficiency can no longer be serenely accepted as inevitable to arterial occlusive disease, and the indications for previously recommended medical and surgical therapies must be readjusted accordingly. Therapeutic objective has been raised above mere survival of the limb. This evolutionary process in the treatment of chronic occlusive disease is active in many clinics, but the knowledge that the arteries in the legs are susceptible to surgical manipulation and restoration to normal patency has not been as vigorously applied to the problem of *acute* arterial occlusion.

Laudable progress in the treatment of acute traumatic arterial injury has been made by Jahnke and Seeley using the principle of restoration of arterial continuity. This report concerns an effort to apply these principles to cases of acute arterial occlusion by emboli and arteriosclerotic thrombosis which by older standards would not be considered amenable to surgery. An aggressive attempt to remove distal thrombus is essential to this surgery and the cases illustrate its value.

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ARTERIAL EMBOLI

Arterial embolectomy has been considered indicated only when the operation is performed early, before extension of thrombosis occurs, and if the location of the embolus and condition of the collateral circulation make limb survival without embolectomy doubtful. The indications for embolectomy should be more liberal than this for two reasons: First, embolectomy can be applied to cases with extension of thrombus since extensive distal thrombus can often be successfully removed as will be related herein. Second, the operation should be performed even in cases in which limb survival is not in doubt since the incidence of chronic ischemic symptoms in those patients who are treated "successfully" without an operation is high.

Early in the history of the operation attempts at embolectomy were unsuccessful, probably as much because the cases were late and secondary thrombus was incompletely removed as because of inadequate techniques in suturing and handling vessels. Later successful experience was with early emboli in which secondary thrombosis had not taken place. The importance of distal thrombosis in causing failure of embolectomy was appreciated early, as this problem was discussed by Key in 1923, but the steady improvement in the results of this operation has come more from early surgery, before secondary thrombosis has occurred,

than from increasing effectiveness in the removal of distal thrombosis.

In 1930, Lund successfully removed distal thrombus in a case of axillary artery embolus by flushing back from the radial artery with salt solution (4). More recently Olwin, Dye, and Julian have reported successful application of this method to late cases of peripheral embolism with extensive distal thrombosis. This is an effective way of dealing with the problem and deserves wider use. Extremity arteries are superficial and accessible at their points of pulsation. They can be exposed distal to thrombus and used for this retrograde flushing maneuver with relatively little prolongation of operative time and risk. Removal of thrombus is accomplished by the forceful injection of 100 cubic centimeters or more of warm heparin saline solution (10 mgm./100 c.c.) up an open artery below the clot using a 50 cubic centimeter syringe and a size 14 or 16 needle. An additional arteriotomy must have been made above the arterial segment being flushed in order to allow withdrawal of the clot after it has been loosened by passive distention of the vessel and washed up within reach. A free flow of saline from the proximal arteriotomy indicates that the vessel is clear. Arteries should never be interrupted after this maneuver since the key to its success is restoration of continuity and re-establishment of flow. Retrograde flushing reinforced by direct milking of the vessel with the fingers has been used in the cases reported.

Fortunately for the success of efforts to remove distal thrombi, the smaller branches of the thrombosed artery may not be invaded by clot. An instance of this is seen during thromboendarteriectomy when, following removal of an ancient thrombus, active back-bleeding from small branches into the previously occluded lumen may be observed. Even where there is extension down the finer arterial branches, clot may sometimes be successfully removed, as in Case 2.

Case 1. An 82 year old woman entered with 30 hours of numbness, coldness, and paralysis of right arm. No pulses were palpable in the right arm which was cyanotic and anesthetic to the elbow. There was no motor function of the hand. She was noted to have slow auricular fibrillation. Five years before admission she had had a myocardial infarction complicated by an arterial embolus resulting in left low thigh amputation. Right axillary embolectomy was performed by Dr. Weldon W. West under local anesthesia 32 hours following the onset of ischemia (Fig. 1). Arteriotomies were performed in the subclavian, axillary, brachial, and radial arteries. Thrombus filled the vessels to a point just short of the radial arteriotomy at the wrist and was removed by retrograde flushing between arteriotomy sites. Following operation there was prompt warming and improvement in color of the hand. There was anesthesia below the wrist and apparent paralysis of the hand and forearm musculature at the time of discharge 1 week later. At the time of death from a myocardial infarction 1 month later, she had a good radial pulse, sensation had returned, and she was beginning to use her hand.

Case 2. A 76 year old woman entered the hospital because of pain, paralysis, and numbness of the left leg appearing suddenly 22 hours before admission. She had been under treatment for coronary artery disease for 1 year and had had auricular fibrillation for 10 days before admission. The left femoral pulse was palpable in the groin, but no pulses were palpable below this point. The leg was cool and cyanotic below the lower thigh, and there was no demonstrable sensory or motor function below the knee. Rigor was noted in the calf musculature. Operation was performed by Dr. Robert R. Linton 23 hours after embolization. The primary embolus at the common femoral bifurcation was removed through a common femoral arteriotomy. Secondary thrombus involved the entire superficial femoral and popliteal artery and extended throughout the tibial arteries (Fig. 2). It was removed by traction on the clot through common femoral and popliteal arteriotomies assisted by retrograde flushing from the popliteal artery and the posterior tibial artery at the ankle. Immediately following this procedure, there was a palpable dorsal pedal pulse. The patient developed considerable edema of the leg and on the sixth postoperative day common femoral vein ligation was performed with removal of clot from the common femoral and saphenous vein. Aside from an episode of oliguria, her postoperative course was otherwise uncomplicated. Within a week she had return of sensation and motor function of the leg and was walking at the time of discharge 15 days after operation. A strong dorsal pedal pulse was present on discharge.

Case 3. A 69 year old woman with auricular fibrillation and mild congestive failure entered the hospital complaining of pain, numbness, and coldness of the left leg of sudden onset 30 hours prior to admission. The left leg was cold and cyanotic below the knee with anesthesia of the foot. No pulses were palpable on the left below a weak femoral pulse, although fem-

oral, popliteal, and dorsal pedal pulses were palpable on the right. An iliac arteriogram showed filling of the distal profunda femoris artery only. Operation was performed by Dr. E. Stanley Crawford 33 hours after the onset of ischemic symptoms. A superficial femoral arteriotomy was made in the groin and a popliteal arteriotomy in the popliteal space. The entire length of the superficial femoral artery was filled with clot and was cleaned out by through-and-through irrigation with heparin saline solution. A 20 centimeter clot was removed from the popliteal and tibial arteries by flushing retrogradely from the posterior tibial artery at the ankle. Following closure of the arteriotomies, a strong dorsal pedal pulse was palpable. This patient died of myocardial infarction 2 years following this episode, and at postmortem examination the femoral, popliteal, and tibial arteries were widely patent.

In all of these cases the limb would certainly not have survived without operation, and without a direct attack on the extensive distal thrombus, embolectomy would have been futile.

Stabilization of circulation with continuing viability of an extremity following the lodgement of an embolus, taken by many as an indication for conservative therapy, bodes well for the performance of a successful embolectomy since it implies that the propagation of thrombus is limited and arrested. Successful removal of a popliteal embolus with its distal thrombus as late as 3½ months after embolization has been reported by Olwin, Dye, and Julian, in such a case.

CASE 4. A 63 year old man with auricular fibrillation since a myocardial infarction 2 years before admission entered because of sudden pain in the right hip, thigh, and leg occurring 9 hours before admission, with numbness of the leg since this time. A faint right femoral pulse was noted on admission. There was normal motor power but diminished sensation of the right foot. The patient was started promptly on heparin anticoagulant therapy. During the next 24 hours, the femoral pulse disappeared although the leg still appeared viable. Thirty-six hours after the acute occlusion, surgical consultation was requested, and a right common iliac artery embolectomy was performed by Dr. Robert S. Shaw. At the time of operation, thrombus had extended distally into the orifices of the profunda femoris artery and approximately 2 centimeters down the superficial femoral artery. The distal end of the clot was extracted through a common femoral arteriotomy, and the remainder washed out by retrograde flushing from this point to the common iliac arteriotomy which had been made primarily. There was prompt improvement in leg circulation following the procedure and at the time of discharge 12 days after operation, there were excellent popliteal and pedal pulses present.

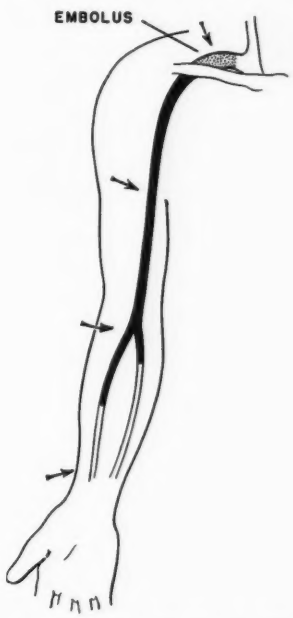

FIG. 1. Preoperative status in Case 1, extensive distal thrombosis following a subclavian embolus. Arrows indicate the sites of arteriotomies used to flush out and remove clot.

In this case the viability of the limb and the age of the embolus, 36 hours, would encourage a conservative course. However, attention to distal thrombus, which was easily removed in the larger vessels involved, allowed restoration of a completely normal circulation.

The high incidence of chronic ischemic symptoms in conservatively treated cases can be realized from examination of the results of popliteal embolization. This lesion carries a lower incidence of limb loss than more proximal emboli. Although embolectomy has been recommended, nonoperative treatment is usual because of the likelihood of not losing the limb and because of alleged technical difficulty in dealing with the popliteal artery surgically. Haimovici in his re-

view of cases of arterial embolization separates those patients with surviving extremities into a group with asymptomatic limbs and a group with chronic ischemic symptoms, a practice unfortunately infrequent. In 38 cases of conservatively treated popliteal embolism, he found 33 patients whose limbs survived, and 16 of these patients had chronic symptomatic ischemia.

These results can be improved since popliteal embolectomy can be successfully performed if attention is paid to distal thrombus. Popliteal embolism occurring during the resection of abdominal aortic aneurysms provided an introduction to the possibilities of popliteal embolectomy in this series.

CASE 5. A 49 year old male with hypertension of 15 years' duration had resection and graft of an abdominal aortic aneurysm which had given symptoms of abdominal pain for 4 months. At the completion of the operation, performed by Dr. Robert S. Shaw, the right leg was seen to be cold and pulseless below the common femoral artery. Superficial femoral arteriotomy at the groin revealed no obstruction to flow and fair back bleeding. Retrograde irrigation from the posterior tibial artery yielded a 5 millimeter piece of firm clot with a 10 centimeter tail of soft thrombus. Following this procedure, the low leg remained profoundly ischemic with a slowly descending abrupt line of demarcation for 8 hours, after which time the limb was hyperemic with a strong dorsal pedal and popliteal pulse. Lumbar paravertebral block did not affect this arteriospasm. Direct warming of the limb seemed to accelerate its disappearance. Two years following operation, the patient had excellent dorsal pedal and posterior tibial pulses.

Since this case there have been 3 additional instances of popliteal embolization complicating abdominal aortic aneurysm resection. Circulation was completely restored in all by surgical extraction of clot. It is of interest that propagation of clot down the tibial arteries was seen in these cases despite the very short interval between embolization and embolectomy.

These later cases were treated with what has become a standard technique in popliteal embolectomy. The popliteal artery is exposed through a vertical incision in the popliteal space. Scar contracture is not a problem here provided a careful closure is done. A vertical popliteal arteriotomy is performed 2 or 3 centimeters above the bifurcation, and thrombus is drawn out of the artery by traction and by reaching beneath the posterior calf muscles and milking the vessels upward from well below the popliteal bifurcation. The vessel is not clamped distally until clot is evacuated for fear of fracturing the thrombus. An over-and-over suture has been found more satisfactory than an everting stitch in closing the arteriotomy in a stiff sclerotic vessel. If the distal end of the removed clot is not blunt and smooth, suggesting that it has been broken, or if pedal pulses do not appear following reestablishment of flow, the vessel is flushed retrogradely from the posterior tibial artery at the ankle. Arteriography on the operating table has been found very useful in defining the presence or absence of thrombus in doubtful cases.

Early popliteal emboli arising from the heart may not have thrombus extending down the tibial arteries and thus may present a very simple technical problem with a gratifying result. Three such cases have been encountered, 2,[1] 5, and 8 hours after embolization. Return of pedal pulses and an excellent result were accomplished in all without retrograde flush, but in 1 case a popliteal arteriogram was required to demonstrate the absence of unremoved distal thrombus.

CASE 6. A 75 year old laborer entered the hospital complaining of pain and numbness of the right leg of 5 hours' duration. Examination showed a cool, pale right foot with normal sensory and motor function, and no pulses palpable below a weak pulse felt high in the popliteal fossa. Strong dorsal pedal and popliteal pulses were palpable in the left leg. The heart showed slow auricular fibrillation. The patient had had an episode of acute cardiac decompensation 1 week prior to admission. Popliteal embolectomy was performed 8 hours after the onset of leg symptoms by Dr. Richard Austin. Fragmented clot was extracted from the popliteal artery and additional fragments were milked upward from below the popliteal bifurcation. The foot showed little change and no return of pulses upon closure of the arteriotomy. Obliteration of the posterior tibial artery prevented retrograde flushing from

[1]Included by permission of Dr. Thomas Risley.

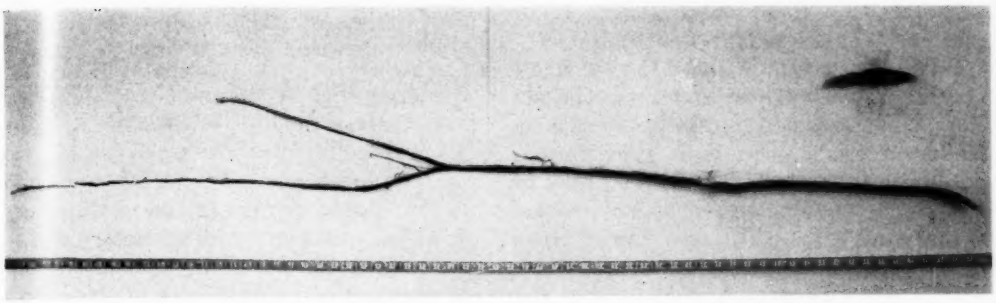

FIG. 2. Surgical specimen removed at operation in Case 2. The primary femoral embolus is shown along with the distal thrombus which extended from the point of embolization well down the tibial vessels.

this vessel. Popliteal arteriogram was performed in the operating room and showed no obstruction in the major vessels below the bifurcation. Two days after operation a strong dorsal pedal pulse was present and the legs remained without apparent deficit in arterial circulation to the time of discharge.

Embolization to the popliteal artery may arise from a proximal segment of arteriosclerotic narrowing in the iliac arteries as in the following 2 cases:

CASE 7. A 57 year old man with intermittent claudication of 6 months' duration involving the left buttock, thigh, and calf entered the hospital because of sudden pain, coldness, and numbness of the left low leg and foot occurring 24 hours before admission. Examination showed a feeble femoral and popliteal pulse on the left with no pedal pulses and cyanosis and anesthesia of the toes. Aortography showed incomplete obstruction at the bifurcation of the left common iliac artery. Operation was performed by Dr. Robert S. Shaw 4 days following the acute arterial occlusion. An arterial homograft was inserted end-to-end between the left common iliac and external iliac arteries. No improvement was noted in the foot circulation, and a femoral arteriogram on the table revealed obstruction at the popliteal bifurcation. At popliteal arteriotomy clot was found extending down the tibial arteries. There was no significant arteriosclerosis in the popliteal artery. Posterior tibial arteriotomy at the ankle exposed the blunt distal end of the thrombus which was removed through the popliteal arteriotomy by retrograde flushing. Arteriotomies were closed but considerable arteriospasm was noted and there was no immediate change in the condition of the foot. At the time of discharge, however, a dorsal pedal pulse was palpable. Two years after surgery, good femoral popliteal, and pedal pulses were palpable, and the patient was free of claudication except for slight fatigue noted in the left gluteal region.

CASE 8. A 61 year old man had been well and free of peripheral circulatory symptoms until 6 days before admission when he suddenly experienced pain in the left calf, numbness of the foot, and cyanosis of the fourth and fifth toes, which symptoms persisted to the time of admission. No pulses were palpable in the groin, knee, or foot on the left. All pulses were present on the right. There was a temperature level just below the left knee with anesthesia and deep cyanosis of the fourth and fifth toes. Aortography showed no filling of the left common and external iliac arteries. Operation was performed by Dr. Robert S. Shaw 10 days after his acute occlusion. A left iliac artery graft was sutured end-to-end between the aorta and the common femoral artery. There were arteriosclerotic narrowing and recent unorganized thrombus in the iliac artery. Femoral arteriography at the conclusion of the procedure showed obstruction at the popliteal artery bifurcation. Popliteal arteriotomy and retrograde flush from the posterior tibial artery resulted in the removal of considerable thrombus similar to that in the iliac artery. There was no arteriosclerotic narrowing in the popliteal artery. The thrombus was adherent and it was impossible to clear the tibial vessels completely. Foot circulation improved following surgery, but a repeat femoral arteriogram showed recurrence of the preoperative obstruction in the popliteal artery. One and a half years following surgery, good femoral and popliteal pulses were palpable. No pulses were palpable in the feet. The toes were of normal color and the patient was asymptomatic.

Although it was not possible here to reestablish flow through the popliteal bifurcation because of old adherent thrombus, it is reassuring that the manipulation involved did not prevent recovery of the leg. An unsuccessful popliteal exploration has not yet been seen significantly to worsen the circulation of an ischemic leg but has complicated

subsequent low thigh amputation in a few cases in which loss of limb was inevitable.

Peripheral emboli arising from the heart may be associated with atherosclerotic occlusive disease which interferes with the reestablishment of good flow. Here thromboendarteriectomy or arterial graft may be used in conjunction with complete removal of thrombus to insure a rapid flow of blood which will prevent the recurrence of thrombosis. The following case illustrates this point:

CASE 9. A 79 year old woman entered because of anesthesia and paralysis of the left leg of 4 hours' duration. Six years prior to admission, the patient had had a right hemiplegia with good recovery and was ambulatory at the time of onset of the present illness. Examination revealed no pulses palpable in the entire left leg which was cold and anesthetic from the midcalf downward. All pulses were present on the right. She had auricular fibrillation at a rate of 120. Operation was performed 7 hours after the onset of symptoms by Dr. George Richardson (Fig. 3). An embolus with a small extension of distal thrombus was removed from the left common iliac artery through a retroperitoneal exposure. Following removal of clamps, a femoral pulse returned, but the circulation of the leg did not improve. Exploration of the superficial femoral artery revealed an area of severe atherosclerotic narrowing in its midportion with fresh thrombus extending distally from this point through the popliteal bifurcation. The atheromatous narrowing was relieved by dividing the vessel immediately below this point, performing a proximal thromboendarteriectomy and an end-to-end anastomosis. The distal thrombus was flushed out through popliteal and posterior tibial arteriotomies. A strong left dorsal pedis pulse was palpable following the procedure, and the paralysis and anesthesia were absent the day after surgery. On the thirteenth postoperative day, the patient had a partial left hemiplegia. She made a fair recovery from this and was able to walk with assistance at the time of discharge on the twenty-sixth hospital day. Her peripheral circulation remained good but she died following another cerebral vascular accident 3 months following discharge.

These cases show that embolectomy can yield good results in patients with distal thrombosis, even when the case is very late and the thrombosis extensive, if the secondary thrombus is successfully removed and good flow re-established. They also show that emboli to the popliteal artery can be successfully managed if this principle is applied.

ARTERIAL THROMBOSIS

In the vast majority of cases of degenerative arterial occlusive disease of the legs, the primary lesion appears to be atherosclerosis in the adductor canal region of the superficial femoral artery with secondary thrombosis. This region is very frequently the site of advanced occlusive disease in the absence of serious narrowing elsewhere in the arteries of the limb. When occlusion occurs, the secondary thrombus may be limited in extent leaving a segmental block in the lower superficial femoral artery with collateral circulation to the popliteal artery which is sufficient to preserve the limb. In a certain number of cases, however, distal propagation of clot will obstruct the popliteal and upper tibial arteries with resulting serious ischemia.

Arteriography on arteriosclerotic patients with very severe lower extremity ischemia most commonly shows occlusion beginning in the superficial femoral artery and extending downward through the popliteal bifurcation. In some of these patients, especially the diabetics, the occlusion will have begun in the smaller vessels and extended upward through the popliteal, but in many the thrombotic process must have started in the lower femoral and have had an open popliteal outflow at the time.

Thus certain cases of acute femoral artery thrombosis could be treated by evacuation of distal thrombus and restoration of continuity past the primary obstruction by arterial graft. The following are such cases.

CASE 10. A 70 year old alcoholic man entered the hospital in shock with an actively bleeding duodenal ulcer. The patient continued to bleed and responded poorly to transfusion. Subtotal gastrectomy was performed by Dr. Robert S. Shaw 9 hours after admission. Vital signs improved with control of his hemorrhage but at the conclusion of the gastrectomy the left leg was noted to be profoundly ischemic. Fifteen hours after operation, despite adequate blood replacement and good stabilization of vital signs, the leg remained ischemic with anesthesia below the midcalf. At this

time the lower femoral and popliteal arteries were explored. An arteriogram after evacuation of fresh clot from the popliteal and proximal tibial arteries showed multiple occlusions of all main arteries in the low leg with good collateral about the points of occlusion. The lower femoral and upper popliteal arteries were thrombosed, narrowed, and sclerotic and were replaced by an end-to-end autograft of popliteal vein. The circulation of the leg showed dramatic improvement, the foot becoming warm and pink with the exception of the fifth toe which was involved in an interdigital septic process with obvious thrombosis of the digital vessels. Postoperatively the patient was treated with heparin and dicumarol anticoagulant therapy; the popliteal wound being closed secondarily 3 days after operation to avoid hematoma. The patient died suddenly on the seventh day after gastrectomy. Postmortem examination revealed the vein graft to be open, but there was extensive bleeding into the pulmonary parenchyma as well as retroperitoneal and splenic hematomas.

This patient probably died of complications of anticoagulant therapy. He was operated on before the retrograde flushing maneuver was used in this hospital. He would not have been a good subject for this because of arteriosclerotic tibial occlusive disease; however, surgery on chronic arteriosclerotic occlusive disease has shown that collateral flow around extensive tibial artery occlusive disease is frequently sufficient to allow a successful femoral artery graft provided the popliteal artery is open.

CASE 11. A 65 year old man with a past history of a myocardial infarction 7 years before admission and a successful right iliac artery graft for intermittent claudication 3 months before admission entered the hospital because of pain and numbness of the left leg and foot of 5 hours' duration. On admission no pulses were palpable on the right leg below the groin. There was a temperature level just below the knee and the toes were anesthetic and deeply cyanotic. Femoral arteriography showed an obstruction in the lower third of the superficial femoral artery with some filling of the popliteal artery below the obstruction. During 6 hours of observation, sensation partially returned to the toes. Eleven hours after the acute occlusion, the lower femoral and popliteal arteries were explored by Dr. E. Stanley Crawford and a 10 centimeter segment of narrowed and thrombosed femoral artery in the adductor canal was resected and replaced by an arterial homograft inserted with end-to-end anastomoses. Foot circulation improved promptly following operation and at the time of discharge 11 days after operation, a strong posterior tibial pulse was palpable. Over the next 4 months, there was gradual weakening of the palpable posterior tibial pulse and femoral arteriography 5 months after operation revealed an occluded graft. At this time the patient complained of intermittent claudication of the left calf, but he had a warm foot with obviously good collateral circulation and had noted no pain or sensory changes in the foot. He died following a cerebrovascular accident 1 year after surgery without further change in his peripheral circulation.

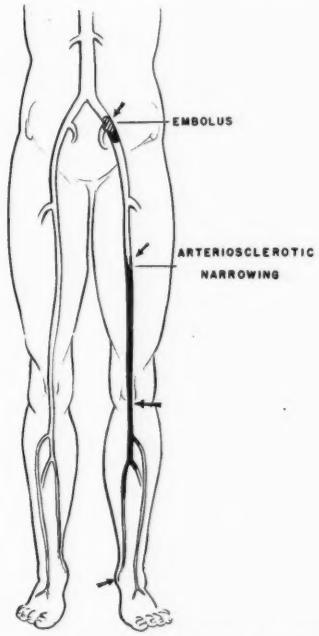

FIG. 3. Preoperative status in Case 9, extensive distal thrombosis following an iliac embolus. The arrows indicate the location of arteriotomies used in the extraction of clot. Thromboendarteriectomy was performed at the area of arteriosclerotic narrowing.

Occlusion of the graft occurred gradually in this case and allowed the patient time to develop collateral circulation. Such late thrombosis may be less likely with the oblique anastomoses currently used in the femoral artery.

Arterial graft was unsuccessfully attempted on 1 additional patient with femoral artery thrombosis of 16 hours' duration and an otherwise unsalvageable limb. In this case it was not possible to clear the distal vessels

because of adherence of thrombus, and low thigh amputation was performed.

It is certainly not established that results in the treatment of acute thrombosis of the sclerotic femoral artery will be improved by such an aggressive approach. However, this therapeutic approach is worthy of further consideration and trial.

In a smaller number of cases acute atherosclerotic thrombosis will occur proximal to the femoral artery in the iliac arteries or aorta. In these larger vessels, the problem of removing the narrowing in the vessel lumen and extracting the adjacent thrombus is much simpler than in the distal smaller arteries, so an aggressive approach to acute occlusion can be recommended with greater confidence.

CASE 12. A 48 year old colored man entered the hospital because of sudden pain in the left hip and leg with numbness of the left leg which occurred while walking 5 hours before admission. Examination revealed a normal heart with no apparent source of emboli. There were no pulses at groin, knee, or foot in the left leg. The left leg was cooler than the right but had normal motion and sensation. The right leg appeared normal. Operation was performed 10 hours after the acute occlusion by Dr. Russel Nelson. A retroperitoneal exposure of the left iliac artery revealed occlusion of the left common iliac artery at its bifurcation by extensive old atheroma and recent thrombus. Thromboendarteriectomy of the common iliac artery bifurcation was performed. Immediately after operation there was a good femoral pulse and the distal leg was warm. Pedal and popliteal pulses were palpable 2 days after surgery. Despite the presence of pedal pulses, the patient developed tenderness and swelling in the anterior tibial region and mild foot drop. Foot extension gradually increased in strength in the weeks following discharge. Eighteen months after operation, there were symmetrical pedal and popliteal pulses in the legs. The patient was without disability and stated that left hip and leg fatigue on climbing, noted for years before surgery, had been absent after surgery.

Another lesion which lends itself to treatment by reconstructive surgery is acute thrombosis of a popliteal aneurysm. This accident is accompanied by a very high limb mortality and the tibial vessels are usually open before thrombosis, so there is both considerable incentive for operation and a good anatomic setup for a successful graft.

This rationale was applied to the following case.

CASE 13. A 66 year old man entered the hospital complaining of pain and coldness of the left foot and calf of 36 hours' duration and increasing intermittent claudication over this interval. On examination no pulses were felt below the groin on the left although normal pulses were palpated in the right lower extremity. The left foot was cold and pale although normal sensation and motion were present. There was a 2 centimeter elongated firm mass palpable in the popliteal space. Femoral arteriogram showed obstruction in the midsuperficial femoral artery with indistinct filling of the anterior tibial artery below the obstruction. During 3 hours of observation, the point of cessation of femoral artery pulsation moved 2 inches proximal to the point in the midthigh where it was palpated on admission. Forty hours after the onset of symptoms, exploration of the popliteal artery was carried out by Dr. E. Stanley Crawford (Fig. 4). Clot in the superficial femoral artery was removed through an arterotomy in the vessel's proximal portion. A 10 centimeter clot in the vessels below the knee was flushed out by heparin saline solution inserted through a needle in the posterior tibial artery at the ankle. The small thrombosed popliteal aneurysm was left in place and by-passed by an arterial homograft inserted end-to-end from midfemoral to lower popliteal artery. There was prompt return of circulation to the leg following surgery and a strong dorsal pedal pulse was palpable on his discharge 10 days later. Two years after surgery, the patient was symptom-free and had strong bilateral dorsal pedal pulses.

Graft was attempted on 1 additional thrombosed popliteal artery 36 hours after onset of symptoms but was unsuccessful because of adherent tibial artery thrombus and resulted in no change in the status of the leg, amputation ultimately being required. Distal thrombus becomes increasingly adherent and difficult to remove with the passage of time, so prompt action remains of paramount importance to the success of reconstructive surgery in any acute arterial occlusion, be it embolic, thrombotic, or traumatic. While this discussion is not directly concerned with arterial insufficiency resulting from trauma, attention to the removal of distal thrombus is of no less importance in dealing with this patient group as the following case illustrates:

CASE 14. A 55 year old intoxicated man entered shortly after having been struck by a car. A head injury was suspected on admission and arterial insufficiency was not noted until 16 hours after admission when he became rational enough to complain of pain in his left leg. The surgical service was consulted and a profoundly ischemic left leg was found with no pulses palpable below a bruised area in the left groin. There was anesthesia of the low leg and foot. At operation, performed by Dr. Richard Austin, a 1 centimeter thrombosed contused segment of the common femoral artery was resected and end-to-end anastomosis performed (Fig. 5). There was good back bleeding from the distal artery. Pulses did not appear in the foot although a popliteal pulse could be palpated. Arteriography in the operating room demonstrated popliteal obstruction. Exploration of the popliteal artery and retrograde flush from the posterior tibial artery yielded a clot 10.5 inches long and resulted in restoration of dorsal pedal and posterior tibial pulses. Postoperatively there was weakness of foot extension and tenderness over the anterior calf musculature, but strength was returning at the time of discharge 15 days after operation.

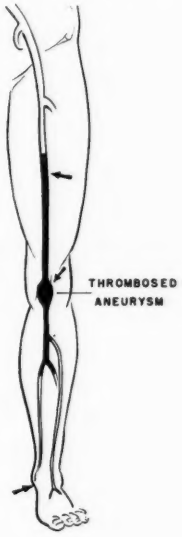

FIG. 4.

FIG. 5.

FIG. 4. Preoperative circulatory status in Case 13, acute thrombosis of a popliteal aneurysm. The arrows indicate the sites of arteriotomies used for the extraction of clot. Continuity was re-established around the aneurysm by means of an arterial homograft.

FIG. 5. Preoperative status of the circulation in Case 14. The arrows indicate the sites of arteriotomies used for the removal of clot. The contused segment of common femoral artery was resected and an end-to-end anastomosis performed.

DISCUSSION

Nonoperative treatment of acute arterial occlusion has as its goal confining the occlusive process to the segment of vessel primarily involved and allowing the development of collateral circulation. Even where this objective is accomplished and the limb survives, one is commonly left with a symptomatic relative ischemia. Anticoagulant therapy often fails to prevent a disaster because of the occurrence of thrombosis prior to therapy or because of the inherent limitation of the method. The segmental arterial obstruction and relative ischemia that is the end result of successful nonoperative treatment is the pretreatment status of many patients whose chronic ischemic symptoms are relieved by arterial graft. "Survival of the extremity" is too frequently taken as the criterion of the successful treatment of acute arterial occlusion. The survival of a limb with prominent persisting symptoms of arterial insufficiency is *not* a good result if, by surgical restoration of arterial continuity, an asymptomatic extremity can be had.

The key to successful reconstructive arterial surgery is the re-establishment of good flow through the manipulated artery which, of course, implies an open distal arterial tree. Good flow is considered to be of far greater importance in preventing postoperative thrombosis than is anticoagulant therapy. Experience in this clinic with arterial grafts has shown that postoperative anticoagulant therapy is unnecessary where good flow is established and may be of no avail in preventing thrombosis where flow is poor. Treatment of the cases reported herein has been undertaken to test the hypothesis that by correction of the primary obstructing process and aggressive and thorough removal of secondary thrombus, restoration of the circulation in the acutely ischemic limb would be more complete and more certain than by other currently recommended methods. It is presumptuous to make sweeping recommendations on the basis of so few cases, but the success of the application of

these principles so far leads us to believe that, certainly with embolism and possibly with all acute arterial occlusion, restoration of normal vascular anatomy should be the first objective and therapy with anticoagulants and sympathetic blocks should be ancillary. Time remains of great importance in the treatment of these conditions, and the best results will be had from prompt restoration of circulation before serious ischemic damage and the propagation of distal thrombus has taken place.

SUMMARY

Cases are reported of acute arterial insufficiency due to thrombosis of atherosclerotic vessels and arterial embolization with extensive secondary thrombosis. These cases were treated as emergencies by re-establishment of arterial continuity with special attention to the removal of secondary thrombi.

Restoration of normal arterial flow should be the primary objective in the treatment of acute arterial occlusion.

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NEW STUDIES IN THE DOG SUPPORTING THE CONCEPT OF EQUAL RESISTANCE OF VARIOUS LEVELS OF THE INTESTINAL TRACT TO ACID-PEPTIC DIGESTION

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THE EXPERIMENTAL LITERATURE of the past half century contains much contradictory evidence relative to the peptic ulcer problem. One facet of this problem which appears to have its share of ambiguous data is the question of the differential sensitivity of the intestine and colon to acid-peptic digestion. It has been generally believed that the sensitivity to acid-peptic attack increases from the duodenum distally. More recent data suggest that this opinion may be unfounded. The conclusion of a difference in sensitivity drawn by previous investigators was entirely logical in terms of the information available to them at the time that their work was done. However, if the earlier work is reanalyzed in terms of subsequent investigation, the results which tended to support the concept of differential sensitivity appear to be explicable on bases other than the implied one. Actually, on re-examination most work supports the thesis of equal or near-equal sensitivity or resistance, and remarkably little contradiction exists.

It is our purpose in this article to review the pertinent experimental work regarding the intestinal sensitivity problem and to present new experimental evidence. For the sake of brevity, the experimental work is classified into groups of similar types of experiments. All experimental work referred to in this paper was performed on the dog.

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GASTRIC TRANSPLANT PROCEDURES

In great measure responsible for the concept of differential intestinal sensitivity was the work by Matthews and Dragstedt in which a gastric pouch (Fig. 1A) (Heidenhain or Pavlov) or that of Dragstedt (1), McMaster, and Kelly and associates in which the entire stomach (Fig.1B) was drained into various levels of the intestinal tract. An increasing incidence of ulceration at the pouch or "stomach-to-intestine" anastomosis was recorded as these transplants were made to progressively lower segments of the intestinal tract. Many factors may be involved in the results reported and will be discussed later.

Two possible explanations, however, are readily apparent. Either the mucosa of the lower levels of bowel is inherently less resistant to acid-peptic attack or the buffering capacity of the intestinal contents delivered to the "pouch-to-intestine" anastomosis is decreased in transit, arriving at the lower intestinal levels with very weak acid neutralizing properties. As previously stated, the purpose of this paper is to challenge the former concept; that the latter is a factor has been amply demonstrated.

When the intestinal contents of various intestinal levels is titrated against both alkaline and acid solution, it is found that the buffering capacity does decrease sharply at progressively lower intestinal levels (9). Similarly, when alkaline solutions (including synthetic laboratory solutions and also normal duodenal secretions) are perfused

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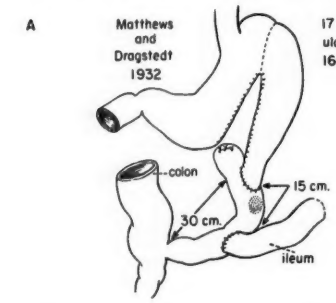

McMaster – 1934
B.

NO. OF DOGS	SITE OF ANAS.	TIME	% ULCERS
4	10-16 CM. PYLORUS	5-12 MONTHS	0
11	JEJUNUM	91-30 DAYS	45
10	15-155 CM. TO COL.	8-74 DAYS	80
10	COLON	20 DAYS	100 *

* Hemorrhagic colitis

FIG. 1

through viable loops of intestine in vivo, it is found that these solutions lose their buffering capacity in direct proportion to the length of the perfused loop.

In an attempt to clarify the significance of the finding alluded to above, the following experiments were performed. Instead of anastomosing Heidenhain and Pavlov pouches into the intestinal tract at various levels, leaving the enteral tract in normal continuity as had been done previously, the segments of small and large intestine to be evaluated were interposed into the duodenum as follows.

METHODS AND MATERIALS

Under nembutal anesthesia, 23 dogs (weighing 6.0 to 17.3 kgm.) were operated upon through a midline abdominal incision. The duodenum was transected distal to the ampulla of Vater and the pancreatic ducts. Isolated segments of bowel with their blood supply intact were then interposed isoperistaltically between the transected ends of the duodenum. End-to-end anastomoses were used to re-establish continuity in the duodenum and also at the site from which the interposed segment was taken. Large Heidenhain pouches (13 dogs) (Fig. 2A) or large Pavlov pouches (10 dogs) (Fig. 2B) were anastomosed into the side of the interposed segment of bowel. These pouches were made as large as possible. The size was estimated at operation as approximately two-thirds of the acid-secreting portion of the stomach. Pouches larger than this left a severely narrowed gastric remnant which would not properly permit the passage of food.

Postoperatively following a 3 to 5 day recovery period, the animals were given a regular kennel diet and were allowed to mix with other dogs in the kennel receiving no special care or treatment. After a suitable observation period the animals were sacrificed with nembutal and the specimens were opened along the greater curvature side of the stomach and through the gastric pouch and duodenum and interposed segment in such a manner that the entire specimen could be laid out flat in one plane (Fig. 2C). Tracings were then made of each specimen and the areas of the pouch and stomach were measured by means of a planimeter. Gross findings were noted and histologic sections were taken across the "gastric pouch to interposed segment" anastomosis.

By actual measurement, the segment of bowel to be tested was placed into the duodenum at distances of from 8 to 17 centimeters from the pylorus. The length of the interposed segment varied from 5.5 to 25 centimeters. The pouch was placed in the center of the transplanted segment.

Five groups of animals were established as follows:

GROUP 1—5 animals. The proximal end of the interposed jejunal segment was taken from 12 to 21 centimeters from the ligament of Treitz.

GROUP 2—5 animals. The proximal end of the interposed jejunal segment was taken from 40 to 75 centimeters from the ligament of Treitz.

GROUP 3—4 animals. The interposed segment of ileum was taken from 140 to 150 centimeters from the ligament of Treitz.

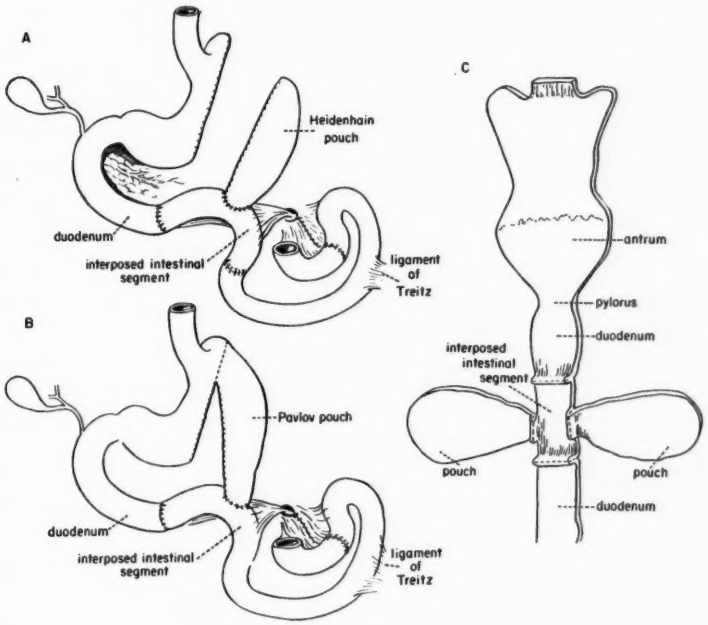

FIG. 2.

GROUP 4—4 animals. The distal end of the interposed ileal segment was taken from 10 to 15 centimeters proximal to the ileocecal valve.

GROUP 5—5 animals. The interposed segment was taken from the colon. (In 1 animal the segment was taken from the transverse colon, W-23, and in the remaining 4 animals the segment was taken from the ascending colon.)

This modification allows the various segments of bowel to be tested under essentially identical conditions. The alkaline juices and food that pass through it will have traversed approximately the same distance prior to their arrival at the gastric pouch. The only variable is the site of orgin of the interposed segment. Furthermore, the animals are physiologically normal, maintaining a good state of nutrition, and are not subject to electrolyte depletion.

RESULTS

No ulceration, either gross or microscopic, was seen in any of the transplanted segments of bowel. Animals were observed from 91 to 477 days with an average of 305 days. All but 1 animal were observed for 176 days or longer. The animals remained healthy throughout the observation period. None of them exhibited vomiting, melena, weight loss, or other evidence of ulcer.

Planimeter measurement of the per cent of the acid-secreting portion of the stomach used in making each pouch is shown in Table I; this figure varied from 29 to 58 per cent. These measurements were taken from the autopsy specimen and these pouches shrink in size after they are constructed in much the same manner that the entire stomach shrinks when it is deprived of food. Again it should be stressed that at operation, in the estimate of the surgeon, approximately two-thirds of the entire acid-secreting area of the stomach was used to construct the pouch. Perhaps this is a more accurate estimate of the actual relationship between pouch and residual stomach size than the autopsy findings. It is unfortunate that square area measurements were not taken at surgery. Nonetheless, it is apparent that a

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TABLE I.—RESULTS IN FIRST GROUP (23 DOGS)

	Dog No.	Type of pouch*	Per cent of stomach in pouch†	Distance from pylorus to interposed bowel segment, cm.	Length of interposed segment, cm.	Origin of interposed segment, distance ligament Treitz to anastomosis, cm.	Length of small bowel, cm.	Gross and microscopic findings	Postoperative days
Group 1.—Bowel taken from upper jejunum	1	H	53	14	10	12	240	Normal bowel	465
	3	H	46	14.5	10	21	200	Normal bowel	474
	11	H	38	12	7	14	—	Normal bowel	201
	12	H	47	17	11	15	240	Normal bowel	374
	66	P	33	13	11	20	250	Normal bowel	176
Group 2.—Bowel taken from lower jejunum	9	H	49	16	14	65	160	Normal bowel	455
	37	H	34	16	23	70	320	Normal bowel	370
	60	P	36	14	16	75	180	Normal bowel	245
	64	P	45	9	17	65	150	Normal bowel	186
	67	P	57	13	15	40	100	Normal bowel	178
Group 3.—Bowel taken from upper ileum	24	H	40	15	19	140	150	Normal bowel	382
	58	P	42	12	26	150	230	Normal bowel	248
	75	P	41	16	16	145	—	Normal bowel	222
	94	P	58	15	19	150	—	Normal bowel	91
Group 4.—Bowel taken from lower ileum	19	H	48	13	16	180	190	Normal bowel	432
	22	H	34	12.5	9	160	175	Normal bowel	477
	57	P	29	9	11	140	150	Normal bowel	212
	73	P	42	12	14	150	160	Normal bowel	151
Group 5.—Bowel taken from colon	15	H	39	15.5	11	colon	—	Normal bowel	426
	23	H	43	16	8	colon	124	Normal bowel	426
	36	H	35	8	5.5	colon	160	Normal bowel	380
	50	H	41	13	8	colon	250	Normal bowel	253
	62	P	30	11	7	colon	200	Normal bowel	196

*Heidenhain—H; Pavlov—P.
†These percentages refer to the amount of the acid-secreting portion of the stomach exclusive of the antrum. These are autopsy findings (see text).

large portion of the acid-secreting stomach was employed.

DISCUSSION

Under the conditions of this experiment, no difference in intestinal sensitivity to acid-peptic digestion was seen for any of the bowel segments regardless of their origin, whether taken from immediately adjacent to the ligament of Treitz or as far distally as the colon. The general health and nutrition of the animals were excellent. This observation is of some importance for it has been observed that starvation and cachexia abet the ulcer diathesis. Perhaps the stress syndrome may serve as an explanation for the occurrence of ulceration in the depleted nutritional state.

It is apparent that an abundant supply of alkaline duodenal juices bathed each interposed jejunal segment. One need only imagine a sufficient quantity and buffering capacity of these juices to neutralize all acid produced by the pouch to explain the results obtained. When these results are compared with those obtained by Matthews and Dragstedt (where a high per cent of ulceration was obtained for the lower levels of bowel), considerable doubt is cast on the concept of increased mucosal sensitivity for progressively lower segments of bowel. If intestinal sensitivity were the only factor responsible for the difference in ulceration encountered in their experiment, one would anticipate the same incidence of ulceration in this experiment. Such was not the case.

This work re-emphasizes the importance of the neutralizing alkaline duodenal juices and gives strong evidence in support of the concept that no important inherent difference in intestinal sensitivity to acid-peptic digestion exists for the intestinal tract from the duodenum to and including the colon.

AFFERENT LOOP EXPERIMENTS

Considerable additional light is shed on the importance of buffering capacity by a

number of experiments involving modifications in the length of the afferent loop when gastrojejunostomy with or without subtotal gastrectomy is performed.

Significant variation in the incidence of ulceration following gastrojejunostomy frequently was observed. The reason for this variation was clarified when gastrojejunostomy, following a 75 per cent gastric resection, was made after the Billroth II plan in such a manner as to vary the length of the afferent duodenojejunal loop (16) (Fig. 3A). It was found that under histamine stimulation no ulcers were encountered until the afferent loop was 27 centimeters or longer. When the afferent loop was 78 centimeters or more in length, spontaneous ulceration (without histamine stimulation) occurred.

Several possible explanations for this phenomenon arise. Is it due to the fact that the lower levels of small bowel are more susceptible to acid-peptic digestion as is often postulated? This concept was evaluated by using the identical preparation mentioned of 75 per cent gastric resection with repair by the Billroth II plan except that the afferent loop was modified in character as follows (10): In one series of animals the duodenum was transected 15 centimeters distal to the closed duodenal stump and 10 centimeter lengths of small bowel were interposed isoperistaltically into the transected duodenum. The gastric remnant was anastomosed end-to-side into this interposed loop. Histamine stimulation was given. No ulceration was encountered in any of the animals even though the intestinal loops were taken from distances of 10 to 62 centimeters distal to the ligament of Treitz (Fig. 3B, series I).

In a second series of animals the afferent loop was modified by dividing the duodenum 8 centimeters distal to the closed duodenal stump and interposing segments of jejunum of various lengths into the transected duodenum. The gastric remnant was then anastomosed into the proximal end of the distal duodenal segment. Thus, afferent loops of various lengths were created. Under histamine stimulation duodenal ulceration

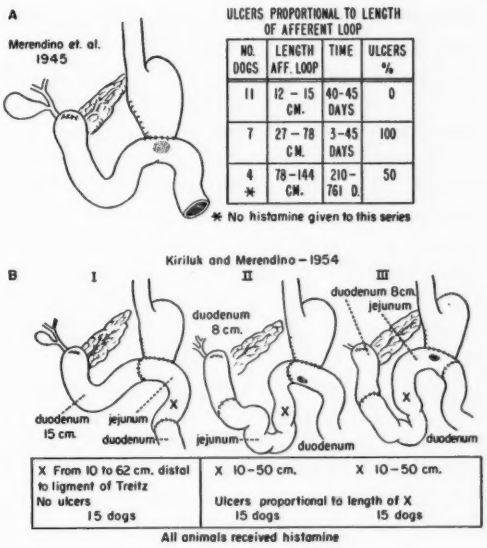
A
Merendino et. al. 1945
ULCERS PROPORTIONAL TO LENGTH OF AFFERENT LOOP
NO. DOGS | LENGTH AFF. LOOP | TIME | ULCERS %
11 | 12 – 15 CM. | 40-45 DAYS | 0
7 | 27 – 78 CM. | 3-45 DAYS | 100
4 * | 78 – 144 CM. | 210 – 761 D. | 50
* No histamine given to this series
Kiriluk and Merendino – 1954
B
I
II
III
duodenum 8cm.
jejunum
duodenum 8 cm.
duodenum 15 cm.
jejunum
duodenum
jejunum
duodenum
duodenum
X From 10 to 62 cm. distal to ligment of Treitz
No ulcers
15 dogs
X 10-50 cm.
Ulcers proportional to length of X
15 dogs
X 10-50 cm.
15 dogs
All animals received histamine

FIG. 3.

began to appear as the length of the loop became 28 centimeters or greater (Fig. 3B, series II).

In a third series of animals when exactly the same preparation as in series II was made except that the gastric pouch was anastomosed to the distal end of the transposed jejunal segment, jejunal ulceration after histamine stimulation occurred when the loop was 23 centimeters or greater in length (Fig. 3B, series III).

Clearly, some factor other than mucosal sensitivity is responsible for the ulceration present with the longer afferent loops. Loss of buffering capacity, as mentioned previously, has been shown to occur when long loops of bowel are employed, and this is probably the most important factor in these experiments. But is it the only factor?

When acid is instilled into the duodenum, gastric secretion in response to sham feeding and food in the stomach is diminished. In these animals with a short afferent loop it is probable that some acid may regurgitate up into the duodenum and thus partially inhibit gastric secretion even in the face of histamine stimulation. But this effect in these

animals must be slight, as histamine stimulation in the animal not operated upon in which acid pours directly on to duodenal mucosa routinely produces ulceration. Thus, duodenal inhibition, though probably present to some extent and of great importance in some situations, is probably not the most important factor responsible for the difference in ulceration in the above preparation where strong histamine stimulation is used. This leaves chiefly the effect of the alkaline duodenal juices and further affirms its importance.

Certainly, the data presented strengthen the concept of uniform resistance of the enteric tract to acid-peptic attack. Some of the work which originally seemed to indicate a difference in intestinal sensitivity has been shown on re-examination to provide additional evidence for the importance of the neutralizing alkaline duodenal juices.

There are other types of experiments that also tended to support the idea of a differential in sensitivity. An analysis of these data is indicated.

DUODENAL REPLACEMENT EXPERIMENTS

A logical comparison of jejunal and duodenal mucosa would appear to be the substitution of jejunal mucosa into the position normally occupied by duodenal mucosa. Any difference in ulceration would seem significant.

Spontaneous duodenal ulceration in the normal dog is practically unknown. But if the duodenum is removed and the jejunum is anastomosed end-to-end to the pylorus replacing the excised duodenum, and the common and pancreatic ducts are transplanted into this segment of jejunum, a low but definite incidence of ulceration is seen in the transplanted jejunum (Fig. 4A) suggesting greater jejunal sensitivity. However, this is not a valid comparison of jejunum and duodenum, for the two types of mucosa are *not* compared under identical conditions. In the dog which has been operated upon, the factors of stress and possible impaired biliary and pancreatic function due to operative interference with their drainage channels are brought into play. That liver function, independent of the neutralizing action of biliary juices, may be a factor in ulceration is evidenced by the findings that dogs with Eck fistulas may develop ulcers. (There is other evidence not to be elaborated on here). In addition, when the duodenum is excised, duodenal inhibition is lost and also the cholecystokinin and secretin factors for flow of biliary and pancreatic secretions are probably markedly reduced. It is interesting to note that when a segment of jejunum was interposed into the pylorus, no ulceration occurred.

DUODENAL DRAINAGE EXPERIMENTS

If the alkaline biliary and pancreatic secretions are drained to a lower level in the intestinal tract, acid-peptic ulceration is encountered in the unprotected mucosa bathed by gastric juices. In other words, when the pancreatic and common ducts are transplanted into the ileum, ulceration occurs in the unprotected duodenum (Fig. 4B). But if the duodenum with its pancreatic and common ducts intact is drained into the ileum and gastrointestinal continuity is re-established by anastomosing jejunum to the pylorus after the Billroth I plan, a much higher per cent of ulceration is seen in the jejunum (Fig. 4C).

This observation would appear to suggest a greater resistance on the part of the duodenum. However, even though the two preparations are identical except for the nature of the mucosa of the gastric drainage channel, these same experiments provide as much evidence for the phenomenon of duodenal inhibition as for difference in sensitivity since no duodenum is exposed to acid in the latter experiments.

Some interesting light was shed on this matter when the experiment was repeated by employing Heidenhain pouch control animals and then converting these animals into the latter preparation (conventional Mann-Williamson preparation). It was found by Storer and associates that secretion

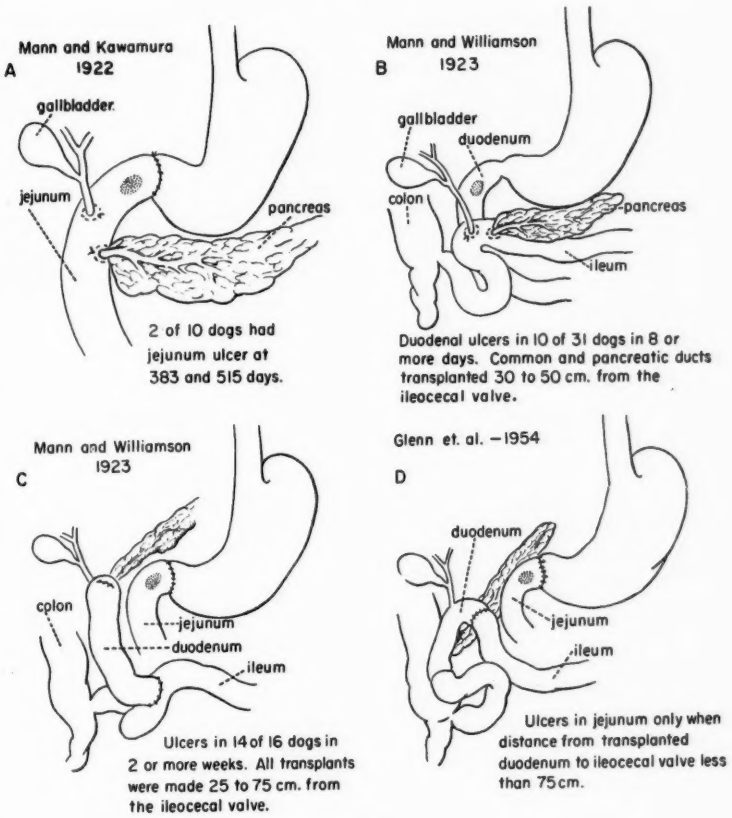
Mann and Kawamura
A 1922
gallbladder
jejunum
pancreas
2 of 10 dogs had jejunum ulcer at 383 and 515 days.
Mann and Williamson
B 1923
gallbladder
duodenum
colon
pancreas
ileum
Duodenal ulcers in 10 of 31 dogs in 8 or more days. Common and pancreatic ducts transplanted 30 to 50 cm. from the ileocecal valve.
Mann and Williamson
C 1923
colon
jejunum
duodenum
ileum
Ulcers in 14 of 16 dogs in 2 or more weeks. All transplants were made 25 to 75 cm. from the ileocecal valve.
Glenn et. al. — 1954
D
duodenum
jejunum
ileum
Ulcers in jejunum only when distance from transplanted duodenum to ileocecal valve less than 75 cm.

FIG. 4.

from the Heidenhain pouch was markedly increased by this operation. Is the increased secretion due to lack of duodenal inhibition or was it in part due to acidosis as suggested by the authors? That acidosis might be a factor was supported by their observation that many of their dogs did have acidosis of mild degree as determined by blood chemical analysis. They further tested this theory by feeding ammonium chloride or creating an external pancreatic fistula in dogs with accessory stomach pouches and noted a striking increase in pouch secretions.

That still other factors may be involved was suggested by the following: Keefer and his associates (6) interposed the duodenum with its common and pancreatic ducts intact isoperistaltically into the small bowel at various levels. This preparation differed from the above preparation in that the segment of duodenum used was actually placed into the intestinal stream by end-to end anastomosis so that the intestinal contents by necessity flowed *through* the interposed segment of duodenum (Fig. 4D). It was found that ulceration was encountered in the jejunum at the gastrojejunostomy stoma only when the duodenum was transplanted in close proximity (less than 75 cm.) from the ileocecal valve.

It seems unlikely that the alkaline juices from the transplanted segment of duodenum could regurgitate far enough proximally to reach the gastrojejunostomy stoma, although other investigators have shown that intestinal contents can reflux retrograde against peristalsis as much as 40 centimeters under

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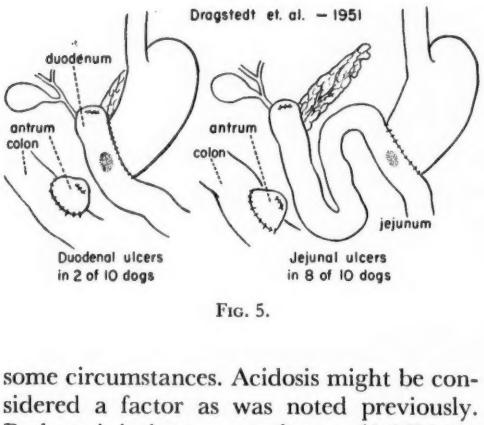

FIG. 5.

some circumstances. Acidosis might be considered a factor as was noted previously. Perhaps it is due to some factor of inhibition of acid secretion by a hormonal stimulus from the duodenal mucosa attending the passage of food over the more proximally placed duodenal segments, as suggested by the authors. In any event, the data available at present suggest that factors other than mucosal sensitivity play a role in the development of ulceration in the various duodenal drainage experiments. Thus, no definite conclusions regarding intestinal sensitivity per se can be drawn from these experiments.

ANTRAL TRANSPLANT EXPERIMENTS

Another experimental "test tool" became available with the discovery that transplanting the antrum into the side of the colon caused marked increase in gastric secretion. After transplanting the antrum into the colon, gastrointestinal continuity was re-established in one group of animals by gastroduodenostomy after the Billroth I plan and in another group by gastrojejunostomy after the Billroth II plan (Fig. 5). Twenty per cent ulceration was seen in the duodenum in the first group as against 80 per cent in the jejunum in the second group; therefore, decreased resistance on the part of the jejunal mucosa was suggested.

However, certain factors (already presented in this paper) are apparent which allow a different interpretation. It has been shown that after intestinal juices have traversed approximately 20 centimeters of small bowel, their buffering capacity falls off sharply. Actual measurement of the distance from the pylorus to the ligament of Treitz in 88 dogs of all sizes (average weight 12.3 kgm., range 5.3 to 22.5 kgm.) averaging 25.6 centimeters (range 16 to 38 cm.). Allowing 5 to 10 centimeters more for even a short loop gastrojejunostomy (distance from the ligament of Treitz to anastomosis) and it is apparent that more than enough length is available for considerable loss in buffering capacity. In effect, this operation is a modified form of "afferent loop" experiment. Furthermore, although it is not known exactly what part and how much duodenal mucosa are necessary for the phenomenon of duodenal inhibition to be brought into effect, it has been shown in dogs that the duodenal contents must have a hydrogen ion concentration of 2.5 or less before any significant inhibition is noted. Since gastric juice does not flow directly on to duodenal mucosa in the Billroth II preparation and must travel some distance retrograde before reaching the duodenal mucosa, some of its acidity may be lost. Some evidence in favor of this idea was obtained when these experiments were repeated using Heidenhain pouch controls. In one series, first a Billroth I type of anastomosis was made, these same animals were later converted to the Billroth II plan and then back again to the Billroth I plan. A second series was started with the Billroth II plan and then converted to the Billroth I plan, and so forth. It was found that the amount of secretion from the Heidenhain pouches was greater with the Billroth II plan of anastomosis, thus tending to substantiate the importance of duodenal inhibition in the observations made. Kelly and Keefer and their associates recently suggested that this increase in acid secretion might be related to the exclusion of food from the duodenojejunal loop. When the stomach was interposed into the jejunum and when the enteral tract continuity was re-established by esophagoduodenostomy, no increase in Heidenhain pouch secretion could be observed in 2 of the dogs.

ACID-PEPSIN DRIP EXPERIMENTS

A useful and direct method of testing the acute reaction of various types of mucosa to acid-pepsin juices is that of the in vivo drip experiments. Various segments of bowel to be tested are exposed at laparotomy to the controlled drip of acid-pepsin solutions. By this means, even though the situation is synthetic rather than physiologic, the mucosa can be exposed to identical conditions of temperature, strength of solution, rate of delivery of solution, and time of exposure. Some contradiction was observed, but the majority of the work indicated no significant difference in sensitivity for duodenum, jejunum, and ileum in the dog. An interesting observation was the tendency of the proximal 1 centimeter of the duodenum to be somewhat more resistant than the balance of the enteric tract. This was noted to be the only area in the dog duodenum that contained Brunner's glands. The degree of resistance noted appeared to be related to the amount of mucus secreted. Yet it is an interesting fact that ulceration often occurs in this portion of the duodenum when the dog stomach is stimulated to hypersecretion by histamine or antral transplant. The jet factor may be of importance in such circumstances.

MISCELLANEOUS

Most of the work to date indicates that there is no significant difference in mucosal sensitivity to acid-peptic digestion for the duodenum and balance of the small bowel. However, 1 experiment that appeared to provide strong evidence in favor of a difference in intestinal sensitivity was a preparation in which a 2.5 centimeter cuff of duodenum was left in continuity with the pylorus with the distal duodenum replaced by a segment of jejunum. The distal duodenum, with its pancreatic and common ducts, was diverted into the lower ileum (Fig. 6A). The appearance of ulceration in the jejunum rather than in the first exposed 2.5 centimeter duodenal cuff appears as strong evidence in favor of a differential in sensitivity.

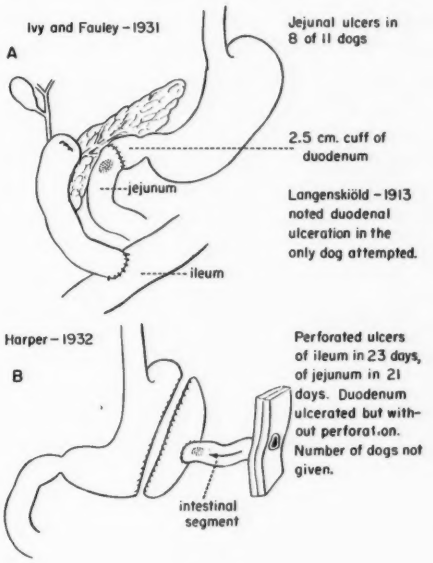
Ivy and Fauley – 1931
A
Jejunal ulcers in 8 of 11 dogs
2.5 cm. cuff of duodenum
jejunum
Langenskiöld – 1913 noted duodenal ulceration in the only dog attempted.
ileum
Harper – 1932
B
Perforated ulcers of ileum in 23 days, of jejunum in 21 days. Duodenum ulcerated but without perforation. Number of dogs not given.
intestinal segment

FIG. 6.

However, duodenal ulceration was noted in a similar preparation employing 1 dog. Furthermore, for all practical purposes, very little duodenal mucosa is exposed to acid-peptic digestion, in contrast to the much larger area of jejunal mucosa exposed.

The small amount of duodenal mucosa exposed is even less than it would appear on first sight, as the pyloric mucosa extends beyond the pyloric sphincter for a distance of approximately 1.0 to 1.5 centimeters. In addition, as mentioned previously, it has been shown recently that the dog has a narrow 1.0 to 1.5 centimeter zone of duodenum immediately contiguous with this pyloric mucosa where Brunner's glands are found. These factors may well explain the difference observed.

Another contradictory result was seen when segments of bowel from various levels were anastomosed to Heidenhain pouches (after the Goldberg technique) to form fistulas between the pouch and abdominal wall. These intestinal segments were placed so that the direction of peristalsis was toward the gastric pouch (Fig. 6B). Ulceration was observed in all types of bowel used, but the

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ulceration was more severe and appeared earlier with ileal and jejunal segments than with duodenal segments.

Since pure gastric juice bathed the intestinal fistula, one might postulate that the effect of duodenal inhibition would be greater when segments of duodenum were used than when jejunum or ileal segments were used. However, one finding which is difficult to explain was the presence of jejunal ulcers in 2 of the dogs in which the jejunum had been brought up to "establish continuity after removal of the lower half of the duodenum."

This latter result was unusual and contradictory to most of the evidence available. However, no explanation other than that of a difference in mucosal sensitivity was apparent.

In order to help clarify some of the confusing experimental data, the following experiment was performed.

"GASTRODUODENOJEJUNOSTOMY"

To our knowledge no work has been done which adequately compares the duodenum and jejunum under essentially *identical* conditions in a physiologically normal and healthy animal.

Consequently, the present experiment is designed to subject duodenal and jejunal mucosa to exactly the same environment in the same animal leaving the gastrointestinal tract in its normal anatomic relationship as well as leaving the animal physiologically normal. The factor of inanition is eliminated. Jet effect is eliminated. The factor of duodenal inhibition is probably not disturbed and the alkaline duodenal juices are allowed to flow normally. The important factor, however, of this preparation is that regardless of what other factors may be introduced, the influence on the two types of mucosa is essentially the same.

METHODS AND MATERIALS

Fifteen unselected dogs underwent excision of the pylorus combined with "gastroduodenojejunostomy" after the Billroth I plan, performed in such a manner that half of the circumference of the drainage channel from the stomach was composed respectively of duodenal and jejunal mucosa. Segments of jejunum were taken from 9.5 to 70 centimeters from the ligament of Treitz and anastomosed side-to-side with the first portion of the duodenum. Continuity was reestablished in the jejunum by end-to-end anastomosis (Fig. 7A).

In some instances, the anastomoses were performed by employing rubber shod clamps placed in identical positions on the duodenum and jejunum. In others, the anastomoses were performed without the use of clamps. Suture material employed was either a double or single layer of running No. 4-0 chromic catgut. Excision of the pylorus provided an outlet channel from the stomach which varied in circumference from 6.4 to 9.0 centimeters. Acid-peptic juice emptied directly into this channel, the circumference of which was composed one-half of duodenum and one-half of jejunum. The length of this combined channel varied from 5.2 to 16 centimeters. Also, the drainage channel was rotated on its long axis in some animals so that different portions of this channel would be most dependent when the animal was standing upright. Three series of 5 animals each evolved as follows:

SERIES I. A segment of jejunum was anastomosed to the side of the first portion of the duodenum (Fig. 7B, inset drawing). The gallbladder was anastomosed to the transplanted jejunal segment in 1 animal(YY-54). The animals were allowed a recovery period of from 20 to 61 days and then were given 30 milligrams of histamine base in oil and beeswax intramuscularly every day. A cholecystjejunostomy 64 centimeter distal to the ligament of Treitz with ligation of the common duct was performed on 1 animal (YY-27) on the eightieth postoperative day, after 50 days of histamine had failed to provoke ulceration.

SERIES II. A segment of jejunum was anastomosed side-to-side to a patch of duodenum varying in length from 8.2 to 10.5 centimeters (Fig. 7C, inset drawing). The distal end of the jejunal segment was anastomosed to the distal segment of the duodenum. Following a 29 to 30 day recovery period, a course of 30 milligrams of histamine base in oil and beeswax intramuscularly every day was begun.

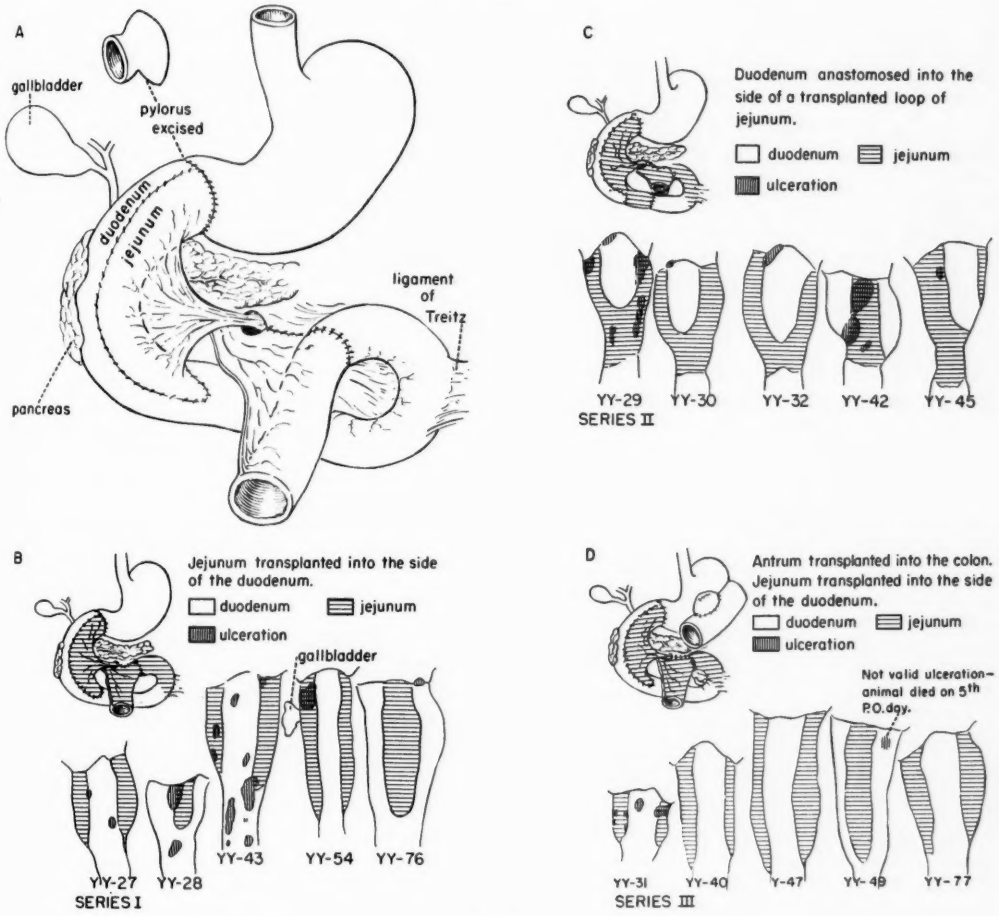

FIG. 7.

SERIES III. This group was identical with series I except that the antrum was transplanted to the side of the transverse colon (Fig. 7D, inset drawing). This latter procedure served as the ulcerogenic stimulus. Only 4 of the 5 animals should be considered as valid animals, since dog YY-49 died on the fifth postoperative day of ileocecal intussusception and showed superficial erosion of the mucosa only, too soon for the appearance of chronic ulceration. This animal had had the common duct transplanted into the jejunal segment.

At autopsy the specimen was removed from each animal and a tracing was made by pressing wax paper against the mucosal surface and scratching the outline of the various types of mucosa, suture lines and ulcers with a stylet (Fig. 7B, C, D). Representative photographs and histologic sections were taken to document the gross findings.

RESULTS

The incidence of ulceration (see Table II) in the duodenal and jejunal mucosa for all practical purposes was the same. All of the animals in series I, 80 per cent of the animals in series II, and 25 per cent of the animals in series III showed ulceration.

The appearance of jejunal ulceration adjacent to the cholecystjejunostomy site (dog

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TABLE II.—RESULTS IN SECOND GROUP (15 DOGS)

Operative procedure	*Dog No. yy*	*Postoperative days prior to histamine*	*Days on histamine*	*Total survival days*	*Length of transplanted segment, cm.*	*Circumference of antral outlet, cm.*	*Distance from ligament of Treitz to site of origin of jejunal segment, cm.*	*Pathologic findings gross and microscopic* — *Duodenum*	— *Jejunum*	*Comments*
Series I.—Jejunal	27	30	50	134*	8.7	6.4	37	+†	+	Death due to volvulus*
segment side-to-side	28	35	12	47	5.2	7.5	70	+	+	Weight loss and vomiting
to the duodenum.	43	30	5	35	12	8.0	24	+	+	Two perforated ulcers
Histamine given	54	61	22	83	14.9	6.0	30	0	+	G.B. transplanted into jejunum
	76	31	85	116	13.8	9.0	9.5	+	0	Weight loss
Series II.—Duodenal	29	30	9	39	8.3	7.9	28	+	+	Melena and weight loss
segment side-to-side	30	29	2	31	8.3	6.8	40	+	0	Death due to distemper
to a transposed seg-	32	30	34	64	10.5	8.3	65	+	+	Weight loss
ment of jejunum.	42	30	24	54	8.2	7.2	—	+	+	Vomiting, melena, weight loss
Histamine given	45	30	15	53	9.0	8.5	45	0	+	Death due to distemper
Series III.—Same as	31	22	—	22	6.0	6.7	49	+	+	Melena and weight loss
series I except antral	40	327	—	327	11.5	7.0	40	0	0	Sacrificed, condition excellent
transplant to the	47	174	—	174	16.0	8.2	40	0	0	Killed in dog fight
colon performed	49	5	—	5	14.8	9.0	48	?	0	C.D. transplanted into jejunum‡
	77	183	—	183	10.5	7.0	24	0	0	Sacrificed, condition excellent

*This animal received histamine for 50 days and was then explored with no ulcers found on external examination of loop. Cholecystjejunostomy was done (64 cm. distal to the ligament of Treitz) and the animal died 54 days later.

†Denotes ulceration.

‡There was superficial erosion only without deep inflammatory cells on microscopic examination. The animal died on the fifth postoperative day of ileocecal intussusception and is not considered a valid test animal.

YY-54) raises the question of the importance of blood supply, as this ulcer occurred in an area of bowel where one might anticipate some impairment to the blood supply. Except for dog YY-49, this argument does not hold true for the balance of the animals in this experiment as the disturbance to the blood supply was similar in the two types of mucosa compared.

DISCUSSION

One consideration in the evaluation of this experiment is the possible influence of blood supply and suture lines on the results. Spontaneous ulceration did not occur in any of the animals and sufficient time (29 to 61 days) was allowed for healing to take place in the first two groups of animals before beginning histamine stimulation. All of these animals were in excellent health. None of them exhibited weight loss, anorexia, vomiting, melena, or other evidence of ulcer, prior to the institution of histamine stimulation. Suture lines were of catgut, and thus no foreign material was left in the suture lines. Examination of the specimen at autopsy showed that in every case healing at the suture line (except for dog YY-49 which died on the fifth postoperative day) was complete. In fact, the junction point of the two types of mucosa in some dogs could only be traced by the scar on the serosal surface. The mucosal surfaces were smooth.

The importance of Brunner's glands in the prevention of acid-peptic digestion is not answered in this article as the area of the duodenum (proximal 1.5 cm.) containing these glands was not specifically tested. However, ulceration was observed in 1 of the animals in an area of the duodenum that contained Brunner's glands.

When these antral transplant results are contrasted with the antral transplant experiments of previous investigators where the Billroth I and II plans were compared, the *equality* of resistance of the two types of mucosa is more apparent. The antral transplant experiment reported here had an incidence of ulceration approximately equal to that of the Billroth I preparation (25 per cent vs. 20 per cent), our procedure also being that of a Billroth I preparation. In other words, the drainage channel of combined duodenum and jejunum in a Billroth I type operation

behaved exactly as if the drainage channel were composed of duodenum alone. If the jejunum were really more sensitive, it should have exhibited the same degree of ulceration as the jejunum in the Billroth II animals (80 per cent).

Although some contradiction exists, and the final exact answer is probably not yet attained, the vast majority of the available information indicates that no important difference in intestinal sensitivity exists for the duodenum and jejunum. If some slight difference does exist, it is of relatively minor consequence contrasted with the other known factors influencing acid-peptic ulceration.

SUMMARY AND CONCLUSIONS

The problem of intestinal sensitivity to acid-peptic digestion in the dog and the results of 2 new experimental preparations have been presented.

1. When the literature is re-examined in the light of more recent work, there is little evidence to support the long accepted concept of a differential sensitivity of the various levels of the small intestine. In actuality, the findings tending to imply this concept appear to be explicable on the basis of other known factors governing the gastric secretory mechanism. Furthermore, most contributions support the thesis of equal or near-equal resistance to acid-peptic digestion of the entire small intestine. A failure to appreciate the importance of alterations in the buffering capacity of the intestinal contents at lower levels of the enteric tract has accounted for much of the error in interpretation of the data.

2. In 23 dogs segments of the jejunum, ileum, and colon were interposed between transected ends of the duodenum 8 to 17 centimeters from the pylorus. A large Heidenhain or Pavlov pouch was anastomosed to each segment. Consequently, each segment was exposed to near-identical conditions of pouch secretion and neutralizing alkaline juices.

No ulcerations were observed in any transposed segment regardless of its site of origin. Had such pouches been anastomosed to these segments in their normal location, a high incidence of stomal ulcer would have occurred at progressively lower levels of the intestinal tract.

These observations substantiate the thesis that stomal ulcer occurring in the lower intestine is related to the reduction in the buffering capacity of the alkaline juices at lower levels of the enteric tract and not to any inherent increased sensitivity of the mucosa of lower levels to acid-peptic digestion.

Under the conditions of these experiments the jejunum, ileum, and colon exhibited equal resistance to acid-peptic digestion.

3. In 15 dogs an operative procedure was devised which exposed the proximal duodenum and jejunum of each animal to as near-identical conditions as possible.

Under histamine or antral transplant stimulation there appeared to be essentially an equal resistance and sensitivity of both duodenum and jejunum to acid-peptic attack.

On the basis of new experimental evidence and re-examination of former work, the concept of equal resistance of the duodenum, jejunum, ileum, and colon to acid-peptic digestion should supplant the earlier contention of differential sensitivity. One exception to this concept may be related to the most proximal duodenum (1.5 cm.) which contains Brunner's glands. This area was not specifically tested in these experiments.

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AN X-RAY PELVIMETRIC STUDY OF RELAXIN EXTRACT IN PELVIC EXPANSION

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THE ROLE of the third ovarian hormone of pregnancy, relaxin, in producing pelvic expansion found in some pregnancies is under our investigation. That relaxin is truly a pregnancy hormone is indicated by studies of the blood of the pregnant rabbit, guinea pig, and sow. The concentration of relaxin increases progressively during pregnancy until a plateau is reached, and it drops precipitously at parturition. The hormone is not found in the blood of nonpregnant females of these species. Similar studies on the human show that relaxin was not detected in the blood of men or of nonpregnant women. A minimum of 0.2 guinea pig unit per milliliter of serum was found at the earliest stage of pregnancy tested, i. e., 7 to 10 weeks. The concentration increased as pregnancy progressed, until it reached a maximal plateau of approximately 2 guinea pig units per milliliter during the last few weeks of gestation. The level fell precipitously at delivery and only about 10 per cent was present 12 hours postpartum. No relaxin was detected by Zarrow and associates in blood drawn 24 hours after delivery (3).

In 1926, Hisaw first postulated that relaxation of the symphysis pubis of the guinea pig during pregnancy is under hormonal control. Since that time a large literature has accumulated concerning this process, and the active principle producing this effect has been named relaxin. Relaxin has been obtained as a water-soluble, polypeptide-like substance from the sera of pregnant animals, particularly the rabbit, and from the ovaries and uteri of other species of mammals. The hormone is rapidly absorbed from the subcutaneous tissue of rabbits or guinea pigs but more than 90 per cent of injected relaxin is lost from the blood 6 hours after intravenous or subcutaneous administration. Histologic study of the symphysis pubis of the guinea pig after the relaxation of pregnancy or following the administration of relaxin shows proliferation of capillaries and dissolution of collagen fibers. Zarrow and Zarrow reported that the administration of early preparations of relaxin to rabbits caused an antidiuretic effect, anemia, and reduction in the nonprotein nitrogen level of the blood (4), but these results were later shown not to be due to relaxin (5).

In the course of human pregnancy, blood "relaxin activity" has been found to increase in a regular manner during the last two-thirds of gestation.

It has long been recognized that the usual obstetric patient will deliver her second and third babies with greater ease and with shorter labor than her first. This is true even though customarily the birth weight of each succeeding child shows a slight increase over that of its predecessor. The decrease in dystocia in each succeeding delivery has in the past been attributed to the dilatation and lacerations of the soft parts of the birth canal, the lower uterine segment, cervix, vagina, and perineum. On this basis, one would expect all multiparous deliveries without positional dystocia to be easier, provided the contractions are efficient and the increase in the size of the baby not excessive. However, an appreciable percentage of primiparous and multiparous second stage labors resemble each other closely. It is, therefore, necessary to consider that other factors may be responsible for inconsistent prognostications of multiparous deliveries.

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TABLE I.—X-RAY PELVIMETRY OF TRANSVERSE INLET (CENTIMETERS*)

Patient	*Before relaxin*	*After relaxin*	*Before delivery*	*After delivery*
M.R.	16.4	16.4	16.5	16.5
B.E.	17.7	17.7	17.8	17.8
M.S.	15.6	15.6	15.9	15.9
P.S.	15.6	15.6	15.6	15.6
M.D.	17.0	17.1	17.3	17.3
J.W.	14.9	15.0	15.1	15.1
P.S.	16.7	16.7	16.7	16.3
M.K.	15.5	15.7	15.7	15.5
C.H.	15.0	15.0	15.0	15.0
P.G.	15.0	15.0	15.2	15.2

*Uncorrected.

Heretofore, the incidence, degree, and clinical significance of pelvic expansion during pregnancy and labor have never been accurately estimated. Allen has noted that the usefulness of pelvimetry at the midplane level is limited, owing to the physiologic increases in the diameters possible during labor. Moir and others have stated that if pelvic measurements are inadequate in the cavity or outlet only, some 25 per cent of easy deliveries may occur, especially in multiparas, because of pelvic expansion. Allen has further remarked that at the midplane the difficulties of deciding whether vaginal delivery is possible are even greater than at the inlet. This is partly because of greater molding of the skull and partly because the diameters at these lower levels are capable of physiologic increase during labor. In 1945 Stander, for example, considered that an exaggerated Sims position would increase the posterior sagittal diameter of Klein, at the outlet by an average of 7.5 millimeters and occasionally by as much as 40 millimeters. Morris, in 1947, indicated the possibility of dislocations and fractures in the region of the sacrococcygeal joint. Marked widening of the symphysis has been reported.

In previous investigations on the subject, the symphysial spread and the sacroiliac joints were measured in nulliparas, primiparas, and multiparas. Regarding the pubic articulation, the symphysis regularly undergoes relaxation with an average increase in width of from 3 to 4 millimeters, there being no essential difference in primiparas and multiparas. The most striking finding has been the tremendous variation in symphysial spread of different persons. The maximum was 30 millimeters and the minimum 3 millimeters. Relaxation begins in the first half of pregnancy, progresses until the last 2 months, and is affected in varying degrees by parturition. Retrogression begins immediately after delivery and is usually complete in 4 months.

In no previous study have the effects of symphysial spread, subluxation of the sacroiliac joints, or other conditions been considered as factors in pelvic expansion. Expansion at the midpelvis has been assumed by Moir and others but has never been accurately estimated. The hormone, relaxin, has been suggested as being responsible for the relaxation.

The question of whether the true bony pelvis undergoes significant expansion before or during labor is certainly more important than how much molding a head can safely undergo, since pelvic expansion is always safe, whereas molding may be dangerous. By studying 171 pregnant patients who had x-ray pelvimetry of 2 or more pregnancies by the same technique 10 days before term, it has been possible to estimate the degree and frequency of pelvic expansion during pregnancy and labor and to estimate its clinical significance (2).

Coronal expansion of the pelvic inlet has been demonstrated in the great majority of pregnancies and to a significant degree in about one-third of the cases. These questions remain to be answered. Does the expansion occur during pregnancy, labor, or delivery? The expansion occurs mostly during pregnancy, but also to some extent during labor and delivery. What are the factors that determine whether expansion will occur? This study showed that the degree of expansion is not dependent on the age of the patient, the weight of the baby, or the difficulty of delivery. The only factor that was significant was that the incidence and degree of expansion was more pronounced in primiparas than in multiparas. Is the expansion permanent? The pelvic expansion is permanent except when it is accompanied by pathologic sym-

physial spread, in which case coronal contraction occurs simultaneously with the reduction of the separation of the symphysis in the late puerperium (6 months). What is the cause for pelvic expansion? Is it due to the effect of relaxin or the physical stress of gestation?

Trials of labor are conducted with borderline pelves and can contribute to perinatal morbidity and mortality. Cerebral palsy is related to some extent to trauma and anoxia of parturition. The bony pelvis is a relatively rigid ring of bone through which a baby must pass without suffering significant injury. Molding of the fetal head as an aid to birth is not desirable if it occurs at the expense of cerebral compression. Pelvic expansion if it occurs naturally, or can be produced, will protect the baby. Relaxin exerts its most powerful effect in some animals (guinea pigs) at the symphysis pubis, in others at the sacroiliac joint (sheep and rabbits). As shown in my previous study, separation of the symphysis can result in a 6 to 9 per cent increase in pelvic dimensions at both the inlet and midpelvis. Since the spread between ample and contracted pelvis is only 15 per cent, these figures for pelvic expansion in conjunction with symphysial spread are significant.

MATERIAL

The relaxin used in this study was supplied as releasin®. Each cubic centimeter contains the equivalent of 20 milligrams of relaxin standard or 3,000 guinea pig units. A guinea pig unit is defined as that amount of relaxin which will induce an unmistakable relaxation of the symphysis pubis in two-thirds of a group of 12 castrated guinea pigs weighing between 350 and 800 grams.

RELAXIN IN WOMEN OF CHILD-BEARING AGE

In order to investigate the action of relaxin in women of the child-bearing age, 4 patients who had undergone physiologic separation of the symphysis during the last month of a previous pregnancy were selected for study. It was logical to assume that these patients had pelves which under the influence of the hormones and physical stress of pregnancy had the capacity to respond by undergoing significant pelvic expansion of about 9 per cent in all transverse diameters. It was further reasoned that if estrogen was given for a period of 2 weeks, the patient would be endocrinologically primed for a reaction to relaxin. These 4 patients were given 2.5 milligrams of premarin twice daily for 15 days. Over a 3 day period, they were then given 5 cubic centimeters of relaxin in saline solution intramuscularly. X-ray pelvimetry was performed before the series of injections and within 12 hours after the last injection.

There was no evidence of separation of the symphysis or increase in the transverse diameter of the pelvic inlet, midpelvis, or pelvic outlet.

TABLE II.—X-RAY PELVIMETRY OF SYMPHYSIAL SPREAD (CENTIMETERS*)

Patient	*Before relaxin*	*After relaxin*	*Before delivery*	*After delivery*
M.R.	.8	.8	.8	.9
B.E.	.6	.6	.8	.8
M.S.	.7	.8	1.0	1.0
P.S.	.7	.7	.7	.7
M.D.	.7	.7	.7	.7
J.W.	.5	.5	.8	.8
P.S.	.8	.8	.8	.7
M.K.	.3	.3	.3	.3
C.H.	.6	.6	.6	.6
P.G.	.7	.7	.8	.8

*Uncorrected.
These distances were not corrected because the significance lies not so much in their absolute measurements as it does in their comparison. The correction of small distances adds a significant error.

RELAXIN IN PREGNANT WOMEN

Although relaxin is undoubtedly a pregnancy hormone, its functions are not clearly defined. One striking effect is that it causes relaxation and separation of the symphysis pubis in guinea pigs which are primed with estrogen. Conceivably, it could be the hormone responsible for spontaneous (nontraumatic) separation of the symphysis pubis in estrogen loaded pregnant women. In an effort to determine whether relaxin administered parenterally would cause pelvic expansion or symphysial spread, a series of 11 primiparous patients were treated with the hormone. Treatment was carried out late in

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the middle trimester at the time that spontaneous separation is supposed to be more common and when the estrogen levels are quite high. The first patient was treated with 15,000 guinea pig units of relaxin (releasin) in saline solution. Roentgenograms were taken of the patient immediately before and 10 hours after the administration, as well as just before and just after delivery. No significant change in symphysial spread or transverse inlet diameter was noted. Because the hormone disappears from serum of rabbits within 6 hours after subcutaneous injection, it was believed that the negative effect could be due to an inadequate dose or a lack of a prolonged action.

The next 10 patients were given the same total amount of releasin in 5 equal daily injections in a repository form, in which the hormone was kept available for the entire 24 hour period. The following day, the x-ray pelvimetric study showed no change. Similarly, x-ray pelvimetry was performed just before and after confinement and showed no change from the original measurements (Tables I and II).

DISCUSSION

It is not clinically feasible to use releasin for long periods parenterally. It is limited in quantity, expensive to produce, and the patients object to prolonged therapy because of the local inflammatory reactions at the site of the injection.

If an oral preparation with relaxin activity were available for continuous usage during pregnancy, further studies might elucidate the role of this hormone in human pregnancy. Lutrexin® (uterine relaxing hormone) is not standardized for relaxin activity and is said to differ from relaxin in its ability to affect the symphysis pubis of guinea pigs and also by electrophoretic analysis. Lutrexin doses contain some relaxin (15 guinea pig units per tablet). We are now engaged in evaluating the pelvimetric response to the long term administration of relaxin extract, orally throughout pregnancy.

SUMMARY AND CONCLUSIONS

A total of 15 patients, 4 nonpregnant and 11 pregnant, in the middle trimester received a relaxin extract (releasin) intramuscularly over a period of 1 to 5 days for a total dosage equivalent to 100 milligrams of a relaxin standard. Under the conditions of the clinical trial there was no evidence of a change in pelvic measurements. It is therefore concluded that relaxin extract, active for a relatively short period of time, is not a significant factor in causing separation of the symphysis or pelvic expansion. We have no proof of its value in the preparation of a patient with a so-called borderline pelvis for a trial of labor.

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THE INADEQUACY OF SURVIVAL RATES IN THE EVALUATION OF CANCER THERAPY

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IT IS GENERALLY AGREED that the undelayed and radical treatment of cancer provides the patient with the best prospect for cure. However, the view has recently been expressed that delayed and conservative therapy may yield equally successful results. The ensuing controversy carries an adverse aspect before the profession and the public. For the profession there is indifference to the customary concept of treatment and invitation to inadequate therapy. For the public there is a lessening of the vigilance appropriate to the early detection of cancer, and the spirit of hope is replaced with the outlook of fatalism. These reactions are undesirable, and the need for revision of the principle of treatment or refinement of the method of evaluating therapy is thus apparent. The purposes of this paper are to reaffirm the principle of treatment and to define the limited usefulness of survival rates in the evaluation of cancer therapy. This is undertaken by formulating the principle of treatment in accordance with the growth pattern of cancer, and by reviewing the factors that affect the interpretation of therapeutic results.

The growth pattern of cancer includes origin at a focal nidus, invasion of adjacent tissues, spread over contiguous surfaces, penetration of lymph channels, and perforation of blood vessels with local or distant dissemination of tumor cells. This process is progressive so that without treatment, tumor cells sooner or later pass beyond the confines of curability. A malignant tumor thus occupies a spatial area, that area constantly enlarges, the rate of enlargement is variable, and the size of the area increases with the duration of the process. The constantly changing factors are time in terms of duration, and space in terms of tissue involvement. In accordance with this growth pattern, the principle of treatment may be formulated from the following premises: (1) Untreated carcinoma is continuously invasive, metastasis is inevitable, and the moment of metastasis is not predictable. (2) Delay in the eradication of cancer is attended by a period during which metastasis may take place. (3) The distribution of tumor cells cannot be determined accurately by clinical examination of the patient. (4) The cure of cancer depends on the eradication of all tumor cells.

The principle of cancer therapy is the eradication of all tumor from the largest amount of tissue with the least possible delay. Since this concept minimizes the factor of time, and encompasses the maximum amount of possible tissue involvement, the results must necessarily be superior to any compromise in either factor. However, delay in the onset of treatment, reduction in the amount of tissue cleared of tumor, or prolongation of the time required to complete treatment will necessarily lessen the prospect for cure. Therefore, the superior method of treatment is that which most closely fulfills the objectives of the principle of treatment.

This concept of cancer therapy has recently been challenged. For carcinoma of the stomach, MacDonald and Kotin state that the results of treatment are determined by "biologic predeterminism," or by "natural selection," and that consequently, the need for early diagnosis and prompt treatment is "so much blind furor against an as yet unacknowledged barrier of biologic inevitability." Deaton (7) reviewed the results of

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treatment of carcinoma of the breast and found that the rate of survival was higher after simple mastectomy than after the radical operation. McKinnon reports that there is no evidence to indicate that superior results attend the early diagnosis and radical treatment of carcinoma of the breast or uterine cervix. For endometrial carcinoma, it has been repeatedly demonstrated that surgical excision clears tumor from more tissue than can be accomplished by the insertion of radium into the cavity of the fundus. Yet it is recommended that operative treatment be delayed for the application of intracavitary radium. These opinions are based on correlations of methods of treatment with rates of survival, and these concepts of cancer therapy are digressions from the principle of treatment.

If the principle of treatment is true, digressions from that principle cannot produce superior results. Therefore, either the principle of treatment is in error, or the results of treatment are misinterpreted. As the growth pattern of cancer is demonstrably correct, and the principle of treatment is therefore necessarily true, it is likely that favorable results after methods digressing from that principle are due to misinterpretation of those results. It is thus in order that the method of evaluating therapeutic results be explored.

The results of treatment are customarily evaluated according to the rate of survival. It is generally proposed that a comparison of survival rates will reveal the superior method of treatment. This proposal is based on the premise that the rate of survival is a reliable expression of the accomplishment of therapy. This premise warrants scrutiny. The survival of a patient treated for cancer is determined by two factors. The first is the distribution of tumor cells at the time of treatment, and the second is the amount of tissue cleared of tumor by the method of treatment. If all tumor cells lie within the tissue encompassed by the therapeutic method, cure is assured. If not, failure is certain. Therefore, survival is determined by the relationship of tumor cell distribution to the amount of tissue cleared of tumor. This relationship is depicted in the following equation, the factors of which determine survival in cancer therapy:

$$\frac{\text{Tissue cleared of cancer}}{\text{Distribution of tumor cells}} = \text{Survival}$$

DISTRIBUTION OF TUMOR CELLS

The distribution of tumor cells at any moment is determined by the duration and invasiveness of the cancer; both are variable. A slowly growing tumor may spread rapidly if vascular penetration occurs early, and a rapidly growing but slowly invasive cancer may attain large local proportions without spreading beyond the confines of curability. Therefore, not all rapidly growing tumors spread early, and not all slowly growing tumors are curable. Two cancers of similar clinical appearance may be attended by an entirely different distribution of tumor cells. Moreover, the distribution of tumor cells cannot be accurately determined by clinical examination of the patient. The palpable features of a mass in the breast cannot possibly reveal whether tumor cells have penetrated vascular spaces and have been carried to regional lymph nodes or to sites of distant metastasis. Indeed, Saphir has pointed out that serial sections are often required to demonstrate minute clusters of metastatic tumor cells in axillary lymph nodes. The difficulty of predicting tumor cell distribution is also illustrated by reference to classification of carcinomas of the uterine cervix. Stage 1 of the International Classification is defined as those cases in which clinical examination reveals the cancer to be "strictly confined to the cervix." Maximum accuracy of this practice should be achieved with such cases because the distribution of tumor cells in stage 1 is more circumscribed than in any other invasive stage. The reliability of this practice may be appraised by determining the incidence of tumor that is deep to the cervix in cases clinically classified as stage 1. These data are presented in Table I which

reveals that a high degree of error attends the practice of predicting tumor cell distribution of cervical carcinoma according to the physical features of the primary tumor. With so-called "silent" cancers of other organs, arising internally and thus not accessible to early examination, even greater errors of estimating the extent of tissue involvement may be expected. Therefore, the precise distribution of tumor cells cannot be determined by clinical examination of the patient, and it is for this reason that the distribution of the tumor cells remains an unavoidable variable of the analysis.

TABLE I.—METASTASES IN PELVIC LYMPH NODES IN STAGE 1 CERVICAL CARCINOMA

Author	*No. of cases*	*Metastases*	
		No.	*Per cent*
Cherry and associates	73	25	34.2
Thomas, Carter, and Parker	51	11	21.6
Meigs	57	10	17.5
Gusberg and associates	48	5	10.4
Schlink	40	1	2.5

TISSUE CLEARED OF CANCER

The accomplishment of the method of treatment is the amount of tissue cleared of tumor. With surgical therapy, the size of the specimen is that measure, since tumor within the specimen cannot subsequently recur within the patient. With radiotherapy, no specimen is provided, and the direct measurement is not possible. However, the accomplishment of radiotherapy is the cancerocidal range of that energy, since eradication of tumor within that range is complete. The cancerocidal range may be measured only when operative removal follows the application of the radiant energy. When residual tumor is not identified in the removed specimen, it is apparent that all tumor cells in that specimen lay within the range of that energy. If metastatic disease develops thereafter, it may be accepted that some tumor cells escaped from the cancerocidal range before the radiant energy was applied. When tumor cells are identified about the periphery of the operative specimen, the cancerocidal range is the distance from the radiation source to the nearest viable tumor cell. When the radiation dose is maximum, and the surgical specimen reveals residual tumor, it is apparent that the operative procedure eradicated tumor from more of the tissue than was possible to accomplish by the employment of the radiation method.

RATE OF SURVIVAL

The survival rate discloses the proportion of cases in which all tumor cells lay within the tissue encompassed by the method of treatment. The survival rate does not reveal the amount of tissue cleared of tumor which is the accomplishment of therapy. For example, if a high proportion of localized carcinomas is present in one series of cases, the survival rate will be favorable after either of comparable methods of treatment because tumor cell eradication will be complete in most. However, if a high proportion of deeply spread carcinomas happens to be present in another series of cases, the survival rate will be unfavorable after either of those methods because tumor cell eradication will be incomplete in many. Therefore, an inferior method that clears tumor from a small amount of tissue will be attended by a high rate of survival if the distribution of tumor cells is localized. Conversely, a superior method that clears tumor from a large amount of tissue will yield a low rate of survival if the distribution of tumor cells is deep and scattered. Therefore, the rate of survival is determined principally by the unavoidable variable of tumor cell distribution. For this reason, discipline should be exercised in the interpretation of survival rates. For example, a survival rate of 70 per cent means that all tumor cells lay within the tissue encompassed by that method of treatment in 70 per cent of those cases. It does not reveal the amount of tissue cleared of tumor, and it does not mean that all tumor cells will lie within that same amount of tissue in 70 per cent of the next series of cases. The paradox of a favorable rate of survival after a method of therapy that digresses from the principle of treatment may be attributed

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TABLE II.—RANGE OF RESULTS ACCORDING TO METHOD OF TREATMENT IN CARCINOMA OF BREAST

Simple mastectomy	*No. of cases*	*5 year survival, per cent*
Deaton and Bradshaw	30	63.3
Nohrman	43	58.1
Lockhart and Ackerman	13	38.4
Byrd and Conerly	61	32.7
Orr	44	18.1
Radical mastectomy		
Clifton and Young	322	54.9
Bell	203	53.6
Haagensen and Stout	495	48.7
Lampe	742	40.2
Orr	195	37.9

to a fortuitous distribution of tumor cells rather than to a superior accomplishment of the method. It may be concluded that the rate of survival is an unreliable expression of therapeutic accomplishment.

Since the rate of survival for each method of treatment is determined primarily by the variable of tumor cell distribution, a wide range of survival rates may be expected to attend different series of cases of the same type that are treated by the same method. This observation is illustrated for carcinoma of the breast and of the endometrium in Tables II and III.

Tables II and III reveal that the effect of the variable of tumor cell distribution on the rate of survival is great. Therefore, a comparison of survival rates may be expected to reveal the superior method of treatment only if the difference in the accomplishment of those methods is substantial. If that difference is slight, such a comparison cannot be successful because it will not be possible to know whether the result should be attributed to the unreliability of the rate of survival or to a difference in the accomplishment of the methods. This conclusion is in accordance with the axiom that a statistical result is no more accurate than the least accurate of the factors that make up the computation. It is thus in order that the difference in the accomplishment of comparable methods of treatment be defined.

TABLE III.—RANGE OF RESULTS ACCORDING TO METHOD OF TREATMENT IN CARCINOMA OF THE ENDOMETRIUM

Radium alone	*No. of cases*	*5 year survival, per cent*
Bourne and associates*	96	47.9
Waterman and associates	28	42.8
Payne	65	40.8
Hall and associates	8	37.5
Hundley and associates	34	20.6
Combined treatment		
Payne	28	92.9
Hundley and associates	32	84.4
Arneson	60	70.0
Taylor and Becker	31	64.5
Scheffey and associates	37	46.0
Primary hysterectomy		
Marshall	31	90.0
Payne	46	80.4
Arneson	43	67.7
Ward	27	63.0
Speert and Peightal	95	48.4

*And/or external radiation therapy.

The difference in the accomplishment of simple and radical mastectomy is the additional amount of tissue cleared of tumor by the latter. However, this difference is reflected in the rate of survival only by the proportion of cases in which some tumor cells lie outside the tissue encompassed by the conservative operation, yet all tumor cells lie within the tissue encompassed by the radical procedure. There is no evidence to indicate that this distribution of tumor cells is frequent. Therefore, the rate of survival, expressing a ratio dominated by the variable of tumor cell distribution, is much too crude an index of therapeutic accomplishment to reveal the superiority of the radical procedure.

However, if the difference in the amount of tissue cleared of tumor by two methods is large, that difference may be disclosed by a comparison of survival rates even though the variable of tumor cell distribution is uncontrolled. For example, endometrial carcinoma is treated with radium alone, with radium before hysterectomy, and with hysterectomy alone. Radium may be expected to cure only those cases in which all tumor cells lie within the cancerocidal range of that agent. Combined treatment is superior to radium therapy by the proportion of cases in which some tumor cells lie outside the cancerocidal range of the radium, yet all tumor cells lie inside the boundary of resect-

able pelvic tissue. This proportion may be substantial, as a tabulation of 495 cases treated with radium and then excised revealed residual tumor in 62 per cent of the total (25), and endometrial carcinoma is ordinarily a slowly spreading cancer. Furthermore, the survival rates after treatment with radium alone, as shown in Table III, are significantly lower than after combined treatment.

Primary hysterectomy and combined treatment clear tumor from the same amount of tissue. In the combined method, operation is delayed 4 to 8 weeks while intracavitary radium is applied. The superiority of primary hysterectomy is thus the proportion of cases in which extrauterine metastasis takes place from tumor cells beyond the cancerocidal range of the radium during that period of operative delay. This event is infrequent because endometrial carcinoma is usually a slowly invasive tumor. Therefore, the superiority of primary hysterectomy over the combined treatment is too slight to be disclosed by a comparison of survival rates until comparability of data can be achieved.

It may be concluded that the number of cases available for analysis is so small, the variable of tumor cell distribution is so great, and the difference in the accomplishment of comparable methods of treatment is often so slight that a comparison of survival rates can seldom be expected to reveal the superior method of treatment. However, selection of the superior method may be of surpassing importance to the occasional patient, and may determine the difference between success and health, or failure and the ravages of metastatic disease. It is, therefore, imperative that a reliable way of identifying that method be available. The amount of tissue cleared of tumor is an infallible guide to the superior method of treatment. It is, therefore, recommended that the method of therapy be selected according to compliance with the principle of treatment rather than by a comparison of survival rates. When the method of therapy eradicating all tumor from the largest amount of tissue is consistently applied at the earliest moment, the best possible result will be achieved regardless of the rate of survival. This program promises the greatest prospect of cure for the patient with cancer.

SUMMARY

The principle of cancer therapy is the eradication of all tumor from the largest amount of tissue at the earliest possible moment. The accomplishment of the method of treatment is the amount of tissue cleared of tumor. The rate of survival does not reveal the accomplishment of the method of treatment. The rate of survival expresses the ratio of tumor cell distribution to the amount of tissue cleared of cancer. The survival rate varies principally with the unpredictable distribution of tumor cells. When the difference in the accomplishment of two methods of treatment is slight, a comparison of survival rates cannot be expected to reveal that difference. Nevertheless, it is invariably true that superiority attends the method most nearly fulfilling the objectives of the principle of treatment. Therefore, compliance with the principle of treatment rather than comparison of survival rates should determine the method of therapy.

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THE EFFECT OF LOWERED BODY TEMPERATURE ON THE CEREBRAL HEMODYNAMICS AND METABOLISM OF MAN

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THE ACCUMULATION of a large amount of data indicating the particular vulnerability of the heart to acute reductions in body temperature has diverted attention away from the response of the other critical organs to hypothermia. Quantitative measurements of the response of the cerebral circulation and metabolism of man to reduced body temperatures have not been reported. Information of this type in man has been indirectly obtained from animal experimentation and the clinical application of hypothermia. One might question whether information obtained from animals whose cerebral integration is less complex than that of man might rightfully be applied to the human patient. Data presently available from studies performed upon animals indicate that hypothermia permits far longer periods of total cerebral vascular occlusion without sequelae than would be possible at normothermic levels. The application of this information to the human patient cannot be made without some confirming studies being performed on man. This study was undertaken to measure directly the response of the human brain to acute reductions in body temperature in those ranges which are being used in the operating room.

METHODS

Studies of cerebral circulation and metabolism were performed on 3 surgical patients while hypothermia was employed as an anesthetic adjunct. The studies were performed in an operating room under strictly controlled conditions. Following the study, surgery was performed. An electrocardiographic tracing was recorded continuously throughout the study. A needle inserted into the femoral artery, attached to a strain gauge manometer and recorder, provided a continuous direct blood pressure tracing. Mean pressure was calculated by planimetry. Continuous body temperature was recorded by a rectal thermopile.

A control cerebral blood flow determination (C) was performed on each unpremedicated patient according to the original nitrous oxide method of Kety and Schmidt. Each patient then received an intravenous injection of atropine sulfate (0.4 mgm.). Under pentothal narcosis plus topical anesthesia, a cuffed nasotracheal tube was inserted. Coughing was controlled by sufficient amounts of pentothal. A second cerebral blood flow determination (E-1) was then performed under moderate pentothal narcosis and spontaneous respiration. The purpose of this blood flow determination (E-1) was to establish the effect of pentothal narcosis upon the cerebral circulation and metabolism of each patient, thus permitting the differentiation between the effects of pentothal and those produced by hypothermia.

Each patient was then wrapped in a conventional cooling blanket through which ice water was circulated. Light first plane anesthesia was maintained by the administration of cyclopropane and oxygen through a closed to-and-fro carbon dioxide absorption

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TABLE I.—EFFECT OF REDUCED BODY TEMPERATURE ON CEREBRAL HEMODYNAMICS AND METABOLISM IN CASE 1

	Normal mean	*Control*	*Pentothal*	*83° F. hypothermia*
Arterial				
O_2 content (vol. per cent)	18	20.5	20.8	23.2
CO_2 content (vol. per cent)	50	44.5	53.9	47.2
pH	7.42	7.42	7.34	7.23
pCO_2 (mm. Hg)	40	38	52	47
Mean blood pressure (mm. Hg)	85	82	82	89
A-V oxygen difference	7	8.5	6.4	8
Hematocrit	45	42.6	49.2	52.8
Internal jugular				
O_2 content (vol. per cent)	11	12	14.4	15.2
CO_2 content (vol. per cent)	55	53.2	55.2	53.4
pH	7.37	7.37	7.30	7.19
pCO_2 (mm. Hg)	50	47	60	70
A-V CO_2 difference	5	8.7	1.3	6.2
Cerebral				
Blood flow c.c./100 gm./min.	54	43	41	12
CMR O_2 c.c./100 gm./min.	3.3	3.7	2.8	0.9
Vascular resistance mm. Hg/c.c./100 gm./min.	1.6	1.8	1.9	7.4

Shivering controlled.

system. Intermittent doses of pentothal sodium were used to control shivering. Each patient continued to breathe spontaneously during the cooling process. Assisted or controlled respiration was not used. When the rectal temperature fell to 84 degrees F., the cooling process and the anesthesia were discontinued. After a period of 20 minutes had elapsed during which time the patient was permitted to breathe room air, a third cerebral blood flow determination (E-2) was made.

Arterial and internal jugular blood samples were analyzed for oxygen and carbon dioxide values using the Van Slyke manometric methods (4). Determinations of hydrogen ion concentration were made anaerobically in a glass electrode and corrected for temperature by suitable factors. Values for carbon dioxide tension were calculated by the nomograms of Van Slyke and Sendroy. Blood volume determinations were made in 2 patients using the Evans blue dye dilution technique.

RESULTS FOLLOWING PENTOTHAL

The changes observed following the injection of pentothal sodium are listed in Tables I, II, and III. Pentothal has been shown to decrease cerebral oxygen consumption with little change in blood flow. The results of the present study are the same as those reported by Wechsler and associates. In 2 of the 3 patients, cerebral oxygen consumption decreased while blood flow remained unchanged. Vascular resistance and arteriovenous oxygen difference decreased.

RESULTS FOLLOWING HYPOTHERMIA

CASE 1. T. E., male, aged 24 years, (Table I) was deeply anesthetized with 500 milligrams of pentobarbital sodium intravenously, 1 gram of pentothal sodium, and cyclopropane. Though respirations did not cease even at temperatures of 79.2 degrees F., respiratory exchange was not completely adequate. At a temperature of 83 degrees F. when the third blood flow study was performed, a respiratory acidosis had already developed as seen in the arterial blood determinations (*p*H 7.42 to 7.23; CO_2 content 44.5 to 47.2 vol. per cent; CO_2 tension 38 to 47 mm. Hg). Internal jugular blood reflected similar changes (*p*H 7.37 to 7.19; CO_2 tension 47 to 70 mm. Hg). At a body temperature of 83 degrees F., cerebral blood flow decreased 72 per cent (43 to 12 c.c./100 gm./min.), cerebral oxygen consumption decreased 76 per cent (3.7 to 0.9 c.c./100 gm./min.), and cerebral vascular resistance increased 311 per cent (1.8 to 7.4 resistance units). The increase in vascular resistance is a reflection of hemoconcentration with a 20 per cent increase in hematocrit (42.6 to 52.8) plus an advanced degree of generalized vasoconstriction. Shivering did not occur in this study.

CASE 2. P. H., male, aged 42 years, (Table II) was only lightly anesthetized with 500 milligrams of pentothal sodium plus sufficient cyclopropane to control shivering. At the time of the third cerebral blood flow determination with a body temperature of 84.8 degrees F., the general response pattern noted in the first patient (T. E.) was repeated. In spite of assisted respiration, respiratory acidosis developed as reflected in the arterial and internal jugular changes in hydrogen ion concentration and carbon dioxide tension. Cerebral blood flow decreased 52 per cent (40 to 19 c.c./100 gm./min.), cerebral oxygen consumption decreased 61 per cent (2.8 to 1.1 c.c./100 gm./min.), and cerebral vascular resistance increased 128 per cent (2.5 to 5.7 resistance units). With a smaller reduction in temperature in this as compared to the first study (T. E.), the cerebral hemodynamic and metabolic changes were not as striking. The development of many ventricular arrhythmias contraindicated a fur-

TABLE II.—EFFECT OF REDUCED BODY TEMPERATURE ON CEREBRAL HEMODYNAMICS AND METABOLISM IN CASE 2

	Normal mean	*Control*	*Pentothal*	*84.8° F. hypothermia*
Arterial				
O_2 content (vol. per cent)	18	16.6	15.8	19.5
CO_2 content (vol. per cent)	50	50.8	54.0	44.2
pH	7.42	7.49	7.50	7.32
pCO_2 (mm. Hg)	40	35	37	44
Mean blood pressure (mm. Hg)	85	107	102	114
A-V oxygen difference	7	7.1	3.9	5.8
Hematocrit	45	39.4	39.8	45.9
Internal jugular				
O_2 content (vol. per cent)	11	9.5	11.9	13.7
CO_2 content (vol. per cent)	55	57.2	56.0	50.8
pH	7.37	7.45	7.47	7.29
pCO_2 (mm. Hg)	50	43	40	53
A-V CO_2 difference	5	6.4	2.0	6.6
Cerebral				
Blood flow c.c./100 gm./min.	54	40	42	19
CMR O_2 c.c./100 gm./min.	3.3	2.8	1.6	1.1
Vascular resistance mm. Hg/c.c./100 gm./Min.	1.6	2.5	2.2	5.7

Shivering controlled.

TABLE III.—EFFECT OF REDUCED BODY TEMPERATURE ON CEREBRAL HEMODYNAMICS AND METABOLISM IN CASE 3

	Normal mean	*Control*	*Pentothal*	*82.6° F. hypothermia*
Arterial				
O_2 content (vol. per cent)	18	17.1	17.0	22.9
CO_2 content (vol. per cent)	50	50.7	52.0	38.5
pH	7.42	7.44	7.33	7.24
pCO_2 (mm. Hg)	40	39	51	46
Mean blood pressure (mm. Hg)	85	93	93	97
A-V oxygen difference	7	3.6	4.0	8.5
Hematocrit	45	40.5	40.0	51.8
Internal jugular				
O_2 content (vol. per cent)	11	13.5	13.0	14.4
CO_2 content (vol. per cent)	55	55.8	56.6	47.1
pH	7.37	7.33	7.31	7.19
pCO_2 (mm. Hg)	50	54	57	64
A-V CO_2 difference	5	5.1	4.6	8.6
Cerebral				
Blood flow c.c./100 gm./min.	54	50	54	44
CMR O_2 c.c./100 gm./min.	3.3	1.8	2.2	3.7
Vascular resistance mm. Hg/c.c./100 gm./min.	1.6	1.7	1.6	2.1

Shivering not controlled.

ther reduction in body temperature without the use of controlled respiration to reduce the severity of the respiratory acidosis. At a temperature of 84.8 degrees F., plasma volume was decreased 51 per cent (2,490 c.c. to 1,290 c.c.).

CASE 3. J. R., male, aged 32 years, (Table III) was lightly anesthetized with 850 milligrams of pentothal sodium and cyclopropane. Shivering, gross and fine, could not be adequately controlled unless greater depth of general anesthesia was employed. Not desiring to introduce other variables into the study, such as the use of curare drugs to control shivering, the use of controlled respiration, or increased depth of anesthesia, the third cerebral blood flow determination was made at a temperature of 82.6 degrees F. with fine and gross shivering present. In spite of assisted respiration, a respiratory acidosis developed which was evident in the arterial and internal jugular blood determinations (pH and CO_2 tension). Cerebral blood flow decreased 12 per cent (50 to 44 c.c./100 gm./min.) and cerebral oxygen consumption increased 105 per cent (1.8 to 3.7 c.c./100 gm./min.). Vascular resistance increased 23 per cent (1.7 to 2.1 resistance units) again reflecting hemoconcentration (hematocrit, 40.5 to 51.8) and vasoconstriction. Plasma volume was decreased 33 per cent (3,590 to 2,370 c.c.) at this reduced temperature.

DISCUSSION

These studies demonstrate, for the first time, the quantitative response of the human brain to over-all reductions in body temperature (Table IV). At reduced temperature levels, cerebral metabolism and blood flow are proportionately reduced, provided that shivering is well controlled. Thus, the brain responds to hypothermia in much the same manner as other body tissues. The results of the first 2 studies (T. E. and P. H.) might suggest that progressive reductions in body temperature produce progressively greater decreases in cerebral metabolism. Bering and his associates, measuring the cerebral metabolic response of monkeys to hypothermia, have demonstrated that this reaction does not occur. Our results confirm their findings that in the human the sharpest drop in cerebral metabolism occurs with body temperature reductions down to 82 degrees F. and that further temperature re-

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TABLE IV.—A COMPARISON OF THE CEREBRAL HEMODYNAMIC AND METABOLIC RESPONSE OF 3 PATIENTS TO REDUCED BODY TEMPERATURES

	T.E. 83° F.			P.H. 84.8° F.			J.R. 82.6° F.		
	1	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*
Cerebral blood flow c.c./100 gm./min.	43	12	72↓	40	19	52↓	50	44	12↓
Cerebral vascular resistance mm. Hg/c.c./100 gm./min.	1.8	7.4	311↑	2.5	5.7	128↑	1.7	2.1	23↑
Cerebral oxygen consumption c.c./100 gm./min.	3.7	0.9	76↓	2.8	1.1	61↓	1.8	3.7	105↑
	No shivering			No shivering			Shivering		

1—Control.
2—Hypothermia.
3—Per cent change.

ductions could not produce a correspondingly great depression of cerebral oxygen utilization. As shown in Case 1 (T. E.), a reduction in body temperature to 83 degrees F., in the absence of shivering, produced a 76 per cent reduction in cerebral metabolism, or a reduction in cerebral oxygen consumption of roughly one-fourth the value at normal body temperature. Since it has been demonstrated that the over-all body metabolism of the dog at a body temperature of 86 degrees F. is reduced to 15 per cent of its value at normothermic levels, one might seriously question the feasibility of decreasing the body temperature from 83 to 68 degrees F. in order to produce an additional decrease in cerebral oxygen consumption of only 9 per cent. Body temperatures in this range predispose the myocardium to serious derangements of rate and rhythm.

In each of the 3 studies, without the use of fully controlled respiration, a respiratory acidosis developed. An increase in arterial carbon dioxide tension usually is a potent stimulus for cerebral vascular dilatation. During hypothermia, however, cerebral vascular resistance increases in spite of elevated arterial carbon dioxide tensions. This increase may be due to 2 factors: first, hemoconcentration in response to hypothermia, reported previously by Prec and associates and confirmed by this study, increases blood viscosity and cerebral vascular resistance. Second, the cerebral vessels may constrict in much the same manner as peripheral vessels in a response to hypothermia. However, direct evidence to confirm this fact is lacking.

The results of the third study (J. R.) demonstrate the effect of shivering upon the human cerebral response to hypothermia. Many investigators have recognized the increase in over-all oxygen consumption produced by shivering. This study demonstrates a similar response in the cerebral metabolism of man. In spite of a greater reduction in body temperature that was produced in the third study (82.6 degrees F.), cerebral metabolism increased 105 per cent above the control value in the presence of shivering. The increase in cerebral oxygen consumption occurred despite a decreasing cerebral blood flow. This pattern of cerebral response to hypothermia with shivering closely resembles that observed following the intravenous administration of l-epinephrine, perhaps suggesting the importance of this drug in the mediation of the shivering reflex. These results demonstrate the danger of assuming that a reduction in cerebral metabolism always follows a reduction in body temperature. Total circulatory interruption at hypothermic levels in the presence of shivering, for longer than 3 minutes could be extremely hazardous.

Hypothermia is used clinically to reduce the over-all oxygen consumption and thus permit longer safe periods during which the blood flow to the entire body or its parts may be interrupted. Clinical and laboratory experience has demonstrated that the total afferent cerebral circulation may be

safely interrupted for only a 3 minute period at normal body temperature. From the results of the first study (T. E.) demonstrating a reduction in cerebral oxygen requirements to one-fourth the needs at normal body temperature, it might be concluded that at a temperature of 83 degrees F., cerebral ischemia could be safely tolerated for a period 3 times as long as the conventional 3 minute interval, or a 9 minute period. This conclusion has been verified clinically in the human by Swan and Bailey and their associates, but at body temperatures below 83 degrees F. Until more knowledge is available concerning the degree of depression of the cerebral metabolism of man at specific hypothermic levels, it cannot be assumed that all patients will respond in like manner. Further studies must be performed.

SUMMARY

1. Direct measurements of cerebral hemodynamics and metabolism during periods of reduced body temperature were made on 3 surgical patients for whom hypothermia was employed as an anesthetic adjunct.

2. In the absence of shivering, cerebral oxygen consumption was sharply reduced at body temperatures of 83 to 85 degrees F. Within this temperature range, cardiac arrhythmias were infrequent.

3. Shivering produces an increase in cerebral metabolism of over 100 per cent even at body temperatures of 82.6 degrees F. The importance of shivering is discussed.

4. Cerebral blood flow decreased in all 3 patients at hypothermic levels.

5. Without the use of controlled respiration, a respiratory acidosis developed in each patient at hypothermic levels.

6. Cerebral vascular resistance increased in each of the 3 patients at reduced body temperatures in spite of a consistent rise in carbon dioxide tension. Hemoconcentration and generalized vasoconstriction in response to hypothermia may have caused this increase.

7. The significance of these results in determining the safe period of total occlusion of the cerebral afferent circulation is discussed.

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THE TREATMENT OF OPERABLE CANCER OF THE BREAST

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IT IS AXIOMATIC IN SURGERY that one should hold to that which is good until something which is demonstrably better comes along. When that happens honest men change. I do not believe the time to abandon the radical mastectomy has arrived.

In an editorial entitled "A Critical Analysis of the Treatment of Carcinoma of the Breast," Thomas C. Case of New York supports the thesis that the Halsted-Willy Meyer radical mastectomy is outmoded and that better results are obtained by "simpler" methods: in particular, simple mastectomy followed by radiation therapy. He states "I do not understand the violent negative attitude of some brilliant men in this field toward the use of the simpler procedures."

My reaction to this theory is based on the belief that good radical mastectomy, followed by radiation therapy where indicated, is still the best treatment for primary operable carcinoma of the breast. The thesis of Case, espoused by others, is, I believe, a retrogression and is actually a negation of experience and of established surgical principles.

In recent years these heretical ideas have been espoused by many apparently able and well-intentioned men. McWhirter in 1948 advocated simple mastectomy followed by radiation therapy and claimed that his results in terms of 5 year survivals are comparable to those following radical mastectomy. He states that axillary dissection is unnecessary if the axillary nodes are not involved. Unfortunately there is no way of determining such involvement preoperatively. We do know, from exhaustive study of specimens by special clearing techniques, that axillary nodes although clinically negative many times are microscopically involved. When the nodes are enlarged and blocked by tumor the lymphatics back to the primary site may be permeated by tumor. A discontinuous procedure transects these lymphatics and local recurrence often takes place. A well established surgical principle is that of resection in continuity; that is, the preservation of the integrity of the cancer field. It has proved of great value in other parts of the body, and one questions its abandonment in the treatment of carcinoma of the breast. McWhirter's technique violates this principle.

There are many reasons for questioning McWhirter's thesis. One of these is that his series is selected. For example, for technical reasons, the method is not considered applicable to the very obese. The fat are notoriously the poorest operative risks; their tumors are apt to be discovered later and postmammectomy edema is more frequent. Therefore, to eliminate this group would improve his relative statistics. Secondly, he uses the 5 year survival rate instead of the 5 year clinical arrest rate which is the basis of most surgical reports. The difference is probably substantial and capable of demonstration. McWhirter believes that the "clinical cure rate" is too unreliable to be of value. At least, however, the patients with known disease could be excluded from his survival group and his statistics lowered accordingly. Thirdly, he recommends a radiation dosage which is frequently not cancerocidal. Friedman and Pearlman in a clinical study of x-ray therapy for recurrent breast cancer state that "we are of the opinion that McWhirter's dosage is inadequate for certain cancers" and that "local tissue intoler-

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ance prevents the routine employment of higher dosages." Fourthly, much is made of the disability following radical mastectomy and little or nothing about the early and late postradiation morbidity and radiation failures with ulcerating frozen axillae and painful brachial plexus invasion. Fifthly, hormone therapy was given to many patients with local or distant recurrences and 220 patients had ovarian sterilization by x-ray immediately following simple mastectomy. This complicates the evaluation of end results.

It is worthwhile at this time to quote extensively from an excellent article by Ackerman who made an exhaustive, on the spot investigation of McWhirter's work. The total number of patients was 1,882 of whom 786 were living after 5 years had elapsed. He actually reviewed 719 cases. He states: "The combination of large fields (of irradiation) and short periods resulted in considerable morbidity. In many cases, minor effects from irradiation were noted . . . However 47 showed extensive irradiation changes, along with multiple fractures of the ribs, clavicle, and/or humerus, or fixation of the shoulder joint. In three instances these changes were so severe that the arm had to be amputated . . . McWhirter has stated that with irradiation therapy axillary lymph nodes are more easily sterilized than the primary breast carcinoma (it is for this reason that he removes the breast and then irradiates the axilla). This is a startling statement for it is contrary to the views of many. It is a clinical supposition rather than a pathological fact.

"...There were several instances in which lymph node enlargement persisted after the completion of radiation therapy, with subsequent surgical removal . . . In all cases the cancer in the lymph nodes showed no detectable effect . . . There are a fairly high number of these patients who have died after the five-year period . . . It is always difficult to be sure that a patient died of intercurrent disease, 247 patients were either dead or dying and 175 of this group were in the operable segment . . . If we take McWhirter's figures for five-year survivals and subtract the number of patients with local or distant evidence of disease, and of those who have died, then his cure rate becomes rather low . . . It can be stated that McWhirter has not proved sterilization of tumor in axillary lymph nodes. In fact, the rather high percentage dying in stage one or two suggests the converse. Of course this is the important group. Those in stages three and four are not a curable group and are in reality candidates for roentgen-ray therapy. It is our belief at the conclusion of this study, if patients are properly selected for radical mastectomy and operated on by the trained surgeon, this method of treatment must yield, in this group, the greatest number of permanent cures."

Leonardo advocates simple mastectomy with preoperative and postoperative radiation except in those cases in which nodes are enlarged and in which the preoperative treatment does not shrink them. In this case "radical mastectomy is indicated, although the probabilities are that the surgery will be ineffectual as far as longevity is concerned." He bases his opinion on a handful of patients—only 1 of whom has passed "the 5 year cure limit"—in which minimal operative procedures were done. For the rest he exaggerates the deformity and morbidity of radical mastectomy and quotes voluminously from McWhirter whom he supports.

The palliative effect of the radical mastectomy is completely ignored by the protagonists of "simpler" methods. If careful technique is used the incidence of skin recurrence due to wound contamination by tumor cells should be around 6 per cent. Even if there is late recurrence elsewhere there is great comfort in a clean chest wall and axilla while other palliative methods are being used.

The protagonists of "simpler" methods are also ignoring the continued improvement in the immediate and late postoperative course of these patients. The most notable, and the simplest, is the use of postoperative suction as advocated by Raffl in his classic article.

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This method will often cause immediate and permanent adherence of skin flaps so that the entire measured serous extravasation is as little as 40 cubic centimeters. It obviates bulky dressings, allows early ambulation, and has cut the length of hospitalization to as little as 6 days. The late dividends in avoidance of lymphedema are yet to be assessed. Postmammectomy edema sometimes occurs months or years following operation, brought on by sunburn, infection, or trauma. These things should and can be avoided.

It has even been suggested that no treatment is of avail for this disease. This ultimate absurdity was the thesis of Park and Lees who stated that: (a) It has not been proved that the survival rate has been affected by treatment at all; (b) treatment is quite ineffectual in reducing the incidence of death from metastatic spread; and (c) if treatment has any effect at all, it cannot have done more than to increase the over-all survival rate by more than 5 to 10 per cent.

This turgid and difficult article merely shows, I believe, that figures can be used to prove anything. It remained for Kraus to demolish this fantasy by using the evidence in Park and Lees' article to prove the opposite; i.e., that treatment *is* effective and the earlier the better. Part of the confusion would seem to be due to the inadequacy of the 5 year survival rate as a measure of success and to its comparison with the 5 year clinical arrest rate which is not a fair one.

These flurries have had value because they have made the breast surgeon examine the basis of his method. They have also done great harm by giving aid and comfort to careless or ill-trained or hurried surgeons by relaxing standards and encouraging a therapeutic nihilism.

An example of this is the report of Mayer and Smith cited by Case which "indicated that in a group of 148 cases of cancer of the breast treated in a small hospital, the patients who were operated on by the more inexperienced group of surgeons who did procedures that fell far short of the recognized radical mastectomy, did better and have a more satisfactory five-year survival rate than those patients operated on by the more experienced surgeons performing radical mastectomy." It is probably true that the larger, more rapidly growing tumors and those with enlarged axillary nodes tended to reach the more experienced men, and that smaller, earlier, less aggressive tumors of borderline malignancy tended to be done by the "more inexperienced group of surgeons." The proportion of elderly women with low grade malignancies in whom simple mastectomy was done may very well have loaded the statistics. This series is not controlled in any scientific sense of the word and to use it as evidence in an argument is therefore dangerous.

The possibilities of the radical mastectomy should be exploited to the full before it is given up. Studies by Shimkin and his coworkers conclude that with present methods of detection and treatment of cancer of the breast, if all patients had a delay of less than 1 month from apparent onset to treatment, a 5 year survival rate of 60 per cent could be achieved. This is 20 per cent higher than the usual survival rates found in the literature and 40 per cent above the 20 per cent survival to be anticipated among women with untreated breast cancer. Here is something to work on which promises results far better than the retrogression to "simpler" methods.

SUPRARADICAL OPERATIONS

Recent studies regarding metastatic spread of cancer of the breast have brought out three basic facts: (1) Nearly 35 per cent of patients with positive axillary nodes have cancer in the supraclavicular nodes. (2) Taylor and Wallace found that 60 per cent of patients with axillary metastases have involvement in the supraclavicular or anterior mediastinal nodes or both. (3) Sixty per cent of patients with cancer in the medial half of the breast have internal mammary node involvement according to Urban and Baker.

Extensions of the scope of radical mastectomy to include the internal mammary nodes, the anterior mediastinal group, or the supraclavicular nodes, or all of them, as far as this writer is concerned, are unproved yet interesting surgical experiments to be evaluated when such experience is complete. In the meantime, however, we are getting valuable data as to the spread of mammary cancer. These formidable procedures are not recommended to the average surgeon in the average hospital. They are an attempt to improve the results obtainable by radical mastectomy and not, as Case says, "obviously proof of the fact that the traditional radical mastectomy must have failed in the treatment of this disease." An attempt to improve a procedure is not an admission of failure but rather is the duty of all physicians.

The areas in the body where efficient node dissection can be carried out are probably limited to the axilla, the neck, the groin, and the mesenteries. In each of these locations there is a fibrofatty envelope which can be removed in toto with minimal invasion of the cancer field. This happy circumstance does not obtain in the anterior mediastinum where nodes are perforce removed piecemeal. When the internal mammary lymphatics are involved there is, according to R. S. Handley, early plaque formation with tumor cells actively growing outside the nodes proper and not readily removable by node dissection.

For these reasons we have not thought it worth while to adopt the Wangensteen supraradical procedure or the Urban chest-wall resection for internal mammary metastases. The Wangensteen procedure would seem to be inefficient and formidable, as Gatch and Culbertson said, "the triumph of hope over experience," and the Urban procedure to be inadequate to accomplish what it sets out to do, being limited in its scope and neglecting the "Grand Central Terminal" nodes near the jugulosubclavian junction. The first procedure involves a thoracotomy. The second involves resection of a portion of the chest wall which, as Haagensen points out, "limits the thoroughness of the removal of the tissues upon the chest wall . . . It is not technically possible in most patients to resect the chest wall in the internal mammary area and at the same time remove the superficial tissues in the mammary area as widely as we are accustomed to in our Halsted type of radical mastectomy."

The triple biopsy of Haagensen, entering the first three interspaces and abandoning mastectomy if internal mammary nodes are found positive, is a valuable surgical experiment and is giving information concerning the behavior of mammary cancer. One questions, however, its long term value as a therapeutic adjunct. I suspect these patients would do better as a group with a radical mastectomy followed by vigorous radiation therapy and with the anterior mediastinum undisturbed.

Our policy, therefore is: (1) To do a radical mastectomy as early as possible with the following precepts in mind. The cancer field must be kept inviolate. Dissection must be gentle, thorough, and sharp, and the wound must not be contaminated by cells liberated during the biopsy. The upper outer quadrant of the breast is the most frequent site for carcinoma of the breast. This being the case, the axilla is the site of primary metastasis in well over half of breast tumors seen in the operable stage. (2) To recommend postoperative irradiation to the anterior mediastinal and supraclavicular lymph nodes through 2 portals in selected cases. This treatment is begun as soon as the wound has healed in: (a) middle half cancers; (b) lateral half cancers where the axillary nodes are involved; (c) inflammatory cancers; and (d) cancers complicating pregnancy or lactation. This radiation is probably rarely curative but it slows tumor regrowth by locking viable cells in fibrous tissue and by obliterating lymphatic channels. The operative area is not primarily irradiated, since this procedure is unnecessary and potentially harmful. If good cancer technique is followed, the incidence of local

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skin recurrence should be about 6 per cent, not enough to recommend the procedure. (3) To recommend surgical castration in women who are actively menstruating. However, this is done with restraint and with the feeling that the procedure is merely palliative, that it does not alter the final result if cancer persists but that it does slow down tumor regrowth and gives the physician more latitude for other hormone therapy in the terminal stages of the disease.

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THE REACTION OF THE WALL OF A VEIN TO THE PRESENCE OF EXPERIMENTAL THROMBUS

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IN A PREVIOUS COMMUNICATION,[1] the effect of introducing retracted blood clot into the portal system of a dog was described. It was found that appreciable amounts could be injected into this system without affecting the health of the animals. The large amounts of blood clot which lodged in the portal radicles disappeared almost completely in a matter of weeks leaving in most cases no macroscopic or microscopic evidence of its presence. These experiments were primarily attempted to gauge the action of clot on the vein wall. This action was minimal and was of the inflammatory type in only 1 of 24 dogs. There was no evidence at any time of any "build-up" of the clot.

Similar experiments to those mentioned have now been done by using thrombus instead of retracted blood clot. The object, again, was to see whether a thrombus brought into contact with undamaged venous endothelium would excite any inflammatory reaction or would lead to further clotting or thrombosis.

TECHNIQUE

In a series of dogs, anesthetized with intravenous nembutal solution (1 ml. per 5 lbs. of body weight), a midline abdominal incision was made. With the intestines packed away, the lower portion of the inferior vena cava was identified and a single tie of silk was passed about it just caudal to the renal vessels. Distal to this tie, 1 to 2 milliliters of a dilute solution of topical thrombin (bovine origin) (1 minim/ml. 50 to 100 N.I.H. units) was injected by using a No. 26 hypodermic needle. A column of blood, 1 to 2 inches in length, in this area immediately coagulated. The abdomen was then closed and the animal left for 1 to 3 weeks. At a second operation the abdomen was reopened, the inferior vena cava identified, and the thrombus removed by opening the vena cava. At this time also, a section of the vena cava in that area was removed for microscopic section. An amount of the recovered thrombus (2 to 5 ml. by bulk) was transferred to a syringe, saline added up to 10 milliliters, and the whole contents forced through a No. 13 cannula, placed in a radicle of the splenic vein from which it passed to the intrahepatic parts of the portal vein. The dogs were sacrificed 1 to 3 weeks later to permit macroscopic and microscopic examination of the liver.

Eighteen dogs were dealt with in this manner. The variable length of time the thrombus was in contact with the inferior vena cava and the portal system and the number of animals studied in each instance is represented in Table I.

FINDINGS

The coagulation thrombus when recovered from the inferior vena cava was usually of a reddish-brown to a yellowish-gray in color and firm, rubbery, and friable in con-

TABLE I.—LENGTH OF TIME THROMBUS IN CONTACT AND NO. OF ANIMALS IN EACH PERIOD

	In portal system		
In vena cava	*1 week*	*2 weeks*	*3 weeks*
1 week	2	3	2
2 weeks	2	4	2
3 weeks	3		

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[1]ROBERTSON, H. ROCKE, PERRETT, T. S., COLBECK, J. C., and MOYES, P. D. The reaction of the wall of a vein to intraluminal blood clot. Surg. Gyn. Obst., 1954, 98: 705.

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FIG. 1. Photomicrograph of the coagulation thrombus used in these experiments. This thrombus, having been induced with the injection of topical thrombin, remained in the vena cava for 1 week. There was no apparent inflammation in the wall of the vena cava.

sistency. In dogs in which the thrombus had been lying in the vena cava for 1 week, there was no apparent attachment; it was floating free and extruded itself when the vein wall was opened. In experiments in which contact was maintained for 2 weeks, the thrombus was usually attached to the vein wall, but quite easily separated as one

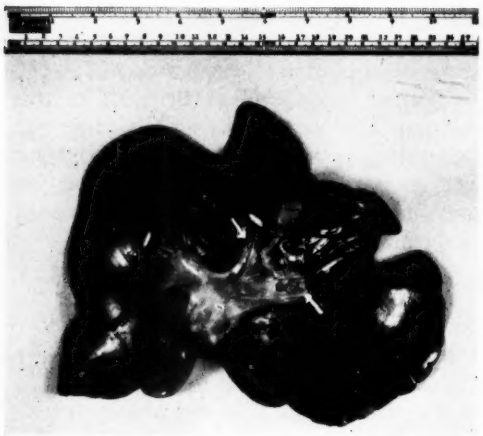

FIG. 2. Photograph of undersurface of liver with porta hepatis opened; 2 milliliters of coagulation thrombus (removed from inferior vena cava where it had remained for 3 weeks) had been injected into the splenic vein 1 week previously. Two deposits of thrombus are shown in the portal radicles. These were of good size but grossly nonadherent.

mass. However, in dogs in which the thrombus was left in situ for 3 weeks, it was difficult of recovery and had to be cut and scraped from the endothelium of the vena cava.

Microscopically, the thrombus itself was composed of an amorphous mass of eosinophilic debris with varying amounts of degenerated red and white blood cells and extensive mineralization (Fig. 1). Particularly at points of attachment to the endothelium, marked organization, fibroblastic reaction, and beginning vascularization were associated with this condition. The free portions of the thrombus, in the older type particularly, were completely endothelialized.

In the microscopic study of the wall of the vena cava, there was little essential difference in the 1, 2, or 3 week period, the variation being only in degree of thickening and vascularization. In only 2 of these sections was there any polymorphonuclear or lymphocytic reaction. This appeared in the adventitia and was patchy and scattered. In both these instances, the abdominal wound of the dog was also mildly infected. In all other sections cellular reaction except by fibroblasts was completely missing. There was very marked thickening of the subintimal and medial layers, infiltration of the endothelium by fibroblasts, particularly in the region of a point of attachment of the thrombus, and vascularization of the media and adventitia. In other words, the process was one of repair but not of inflammation.

The gross appearance of the dissected liver removed at intervals of 1, 2, and 3 weeks after the splenic vein injection of thrombus showed remarkably little change. In all cases it was possible to find 1 or 2 small masses of gray-green thrombus, always in the porta hepatis and usually as a saddle resting on a bifurcation. These were rather firmly attached to the endothelium, particularly in the older specimens. Although 2 to 5 milliliters of thrombus had originally been injected, it was never possible to recover more than 0.5 milliliter and

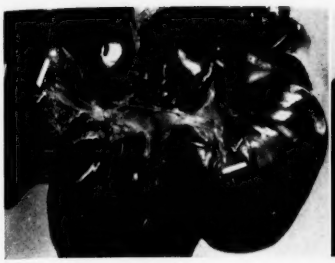

FIG. 3.

FIG. 4.

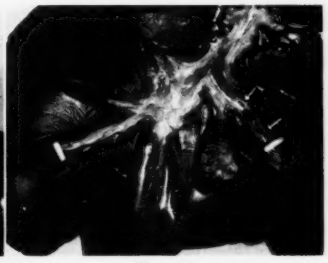

FIG. 5.

FIG. 6.

FIG. 7.

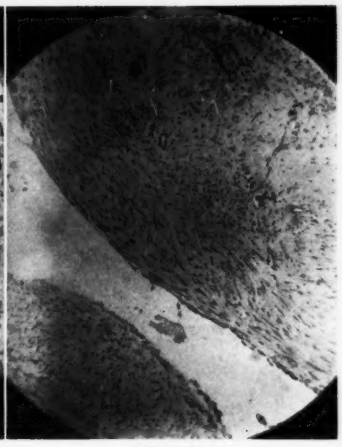

FIG. 8.

FIG. 3. Photograph of undersurface of liver with portal radicles opened. Two weeks previously about 2 milliliters of coagulation thrombus (obtained from vena cava) had been injected into the splenic vein. All that remained at this time were a few small loosely adherent masses of thrombus in the smaller, more proximal radicles of the porta hepatis.

FIG. 4. Photograph of liver with veins of porta hepatis opened. Coagulation thrombus, which had remained in inferior vena cava for 1 week, was injected into the splenic vein and portal system in which it remained for 2 weeks. Only 2 small nonadherent portions of the thrombus are still apparent in this photograph, both straddling a bifurcation of a vein.

FIG. 5. Photograph of undersurface of liver with veins and their radicles opened. Two milliliters of coagulation thrombus had been injected into the splenic vein 3 weeks previously. There remained only 2 minute deposits of thrombus in 1 of the radicles—each measured about 3 millimeters in diameter and both were quite adherent.

FIG. 6. Photograph of a coagulation thrombus which had been present in the inferior vena cava for 3 weeks and which had then been injected into the splenic vein. One week later, it was seen within the portal vein and was represented as a mass of acellular eosinophilic material and giant cells and showed partial organization at its periphery. The adventitia of the portal vein showed infiltration by mononuclear cells only.

FIG. 7. Photomicrograph of a coagulation thrombus which had remained in the inferior vena cava for 1 week before being injected into the portal system where it rested for 3 weeks. In the portal vein, there was a hemispheric mass of fibrous tissue attached to the thickened intima. A short distance from this attachment the intima was normal. There was also considerable thickening of the media at the point of attachment of this thrombus. There was no significant inflammatory reaction throughout the wall except a slight increase of mononuclear cells.

FIG. 8. A photomicrograph of a coagulation thrombus which had remained in the inferior vena cava for 1 week before being injected into the splenic vein. Three weeks later, it was seen in the portal vein as a mass of amorphous eosinophilic material with small areas of mineralization and advanced peripheral organization and fibrosis. The wall of the vein showed cuboidal reaction of endothelium and slight vascularization of media. There was no inflammatory reaction.

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in most cases less than this. The recoverable masses of thrombus were larger in the specimens in which the injected material had been present for the least time (Figs. 2, 3, 4, and 5).

In the microscopic sections through areas in which the thrombus had remained, a similar appearance was seen no matter what the age of the experiment. This was a well organized and endothelialized thrombus composed of amorphous eosinophilic and basophilic debris with marked mineralization. There was infiltration of the attached pedicle with mononuclear cells (plasma cells and fibroblasts). Giant cells were plentiful. Also at the points of attachment the portal vein was thickened with very prominent endothelium and beginning vascularization. The significant point was that in no section was there infiltration by inflammatory cells (polymorphonuclears or lymphocytes) (Figs. 6, 7, and 8). The appearance varied little from that seen in the inferior vena cava. Sections from other portions of the liver were normal. It may be noted here that in all dogs sacrificed, the lungs were examined but no significant abnormality was found.

CONCLUSIONS

1. Coagulation thrombus, when it lies dormant in a vessel such as the inferior vena cava of a dog, becomes organized and covered by endothelium. It does not incite an inflammatory reaction in the wall of the vein.

2. When such a thrombus is injected into the portal vein of a dog, it partially disappears with the remainder becoming organized and endothelialized. In no instance was there any evidence that a thrombus introduced into the lumen of a normal vein would excite any but the mildest inflammatory reaction in the wall of the host vein and never was there any evidence that an injected thrombus excited any additional clotting or thrombosis.

BENIGN TUMORS OF THE LIVER

II. Hemangiomas

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HEMANGIOMAS are more common in the liver than in any other internal organ and they are usually of the cavernous type. Such hepatic tumors are found frequently at necropsy or incidentally at operation. They are usually single but may be multiple, and only occasionally are they large enough to cause symptoms.

This part of our study of benign tumors of the liver is concerned with 35 hemangiomas of the liver found at surgical exploration of patients at the Mayo Clinic from 1907 to 1954, inclusive. Only cases in which satisfactory tissue was available for study are included. Fourteen of these patients have been reported on previously by Preston and Priestley. Eleven patients (group A) underwent surgical exploration because of clinical manifestations thought to be caused by the tumor, whereas 24 patients (group B) were explored for some other condition, the hemangioma being discovered incidentally. These two groups will be presented separately.

REVIEW OF THE LITERATURE

According to Frerichs, hemangiomas of the liver were recognized and described by Dupuytren and Cruveilhier but he credited Rokitansky and Virchow as being the first to examine these lesions carefully. With regard to his own cases, Frerichs said none of the lesions had caused symptoms and he concluded that their pathologic and clinical importance was extremely slight. Virchow, in 1863, described cavernous tumors up to 4 centimeters in diameter and said that the destruction of hepatic tissue kept pace with the growing angioma, resulting in no increase in the size of the liver. Payne, in 1869, reported a necropsy at which multiple hemangiomas were found to involve the liver, suprarenal capsule, ovaries, and uterus. Major and Black discussed the various theories of pathogenesis that had been considered up to 1918, and reported the largest hemangioma (18,160 gm.) that had been recorded up to that time. Excellent reviews of the literature have been published since by Peck, Eckles, and, more recently, Shumacker, who presented an analysis of 66 cases reported in the literature and 1 case of his own.

GROUP A: EXPLORATION DONE BECAUSE OF TUMOR

As already indicated, surgical exploration was done in 11 patients because of symptoms thought to be produced by the tumor. A summary of data in these patients is presented in Table I.

Clinical features. Ten of these patients were women and 1 was a baby boy. The youngest patient was 14 months of age. The remaining 10 patients ranged from 42 to 58 years of age, their average age being 47.8 years. The average duration of symptoms was 3.6 years, the longest duration being 20 years.

The chief symptoms in 10 of these 11 patients consisted of a mass in 5, fullness of the abdomen in 2, pain in 2, and vomiting in 1; a persistent deformity of the stomach was

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Abridgment of portion of thesis submitted by Dr. Henson to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery.
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TABLE I.—SYMPTOMATIC ANGIOMAS OF THE LIVER RESULTING IN SURGICAL EXPLORATION (11 CASES)

	Clinical features					*Lesion*		
Case	*Age, years*	*Sex*	*Chief complaint*	*Duration of symptoms*	*Roentgenologic findings*	*Size, cm.*	*Site, lobe*	*Follow-up, years*
1	55	F	Pain	2 months	—	15	L	—
2	47	F	Mass	3 years	Mass	15	R	8
3	56	F	Mass	2 years	Mass, elevated diaphragm	40	R	12
4	43	F	Pain	4 months	—	6	R	18
5	1¾12	M	Mass	4 months	Mass	17	R	Died 15 hours after operation
6	43	F	Vomiting	5 years	—	4	L	9
7	42	F	Fullness	3 months	Mass, elevated diaphragm	15	L, multiple	7½
8	43	F	Mass	1 year	Mass	—	L and R	7
9	58	F	Fullness	20 years	Displaced kidney	—	R	—
10	45	F	Mass	—	—	11	R	3
11	46	F	None	—	—	—	L	13

noted during gastroscopy in the last instance. Subjective symptoms were absent in the remaining patient, who was found to have an abdominal mass upon a routine examination.

Palpable masses were found on examination in 9 patients, whereas a tumor was seen during gastroscopy in 1 patient. The tumor was described as occupying the epigastrium in 3 patients and the right upper abdominal quadrant in 2; it extended halfway to the umbilicus in 1 and to the umbilicus or beyond in 3 patients. The mass was described as being soft, smooth, or nodular; it was slightly compressible in some instances, and it moved with respiration in all cases. The tumor was slightly tender in 3 patients.

Laboratory findings. Hepatic function was studied in 6 of the 11 patients in group A. Results of studies using sulfobromophthalein were normal in all instances. Three patients had very slight increases in values for serum bilirubin; 2 of these patients later had normal values for bilirubin on several occasions after roentgen therapy had diminished the size of the tumor. Results of other liver function tests done less frequently were all within normal limits.

Roentgenologic findings. Roentgenograms showed abnormalities in 6 of the 11 patients; a soft tissue mass was present in 5 patients, an elevated diaphragm in 2, and a displaced kidney in 1. Scattered zones of calcification were observed throughout 1 tumor.

Diagnosis. The preoperative diagnosis was that of an indeterminate mass in each instance. Three tumors were known to involve the liver as determined by previous exploration. The tumor in 2 other patients was thought to involve the liver but in no patient was a definite diagnosis of hemangioma of the liver made. One patient was thought to have a leiomyoma of the stomach because of the persistent deformity seen on gastroscopy.

Pathologic features. The findings at operation consisted of a tumor involving the liver, which was usually described as being irregular or lobulated (Fig. 1). The size of the tumor varied from 4 to 40 centimeters, with an average of 15 centimeters. Definite measurements were not recorded in 3 instances; these masses were described as involving the entire left lobe in 1 patient, as involving the entire right lobe in 1 patient, and simply as large in the last patient. The tumor involved the right lobe in 6 patients, the left lobe in 4, and both lobes in 1. One patient had multiple tumors confined to the left lobe.

The consistency varied from soft and cystic to that of a firm and solid mass that was well demarcated. The color varied from reddish-brown to purple. Associated conditions found at operation included gallstones in 3 patients, a duodenal ulcer in 1, fibromyomas of the uterus in 2, and carcinoma of the thyroid and achlorhydria in 1 patient, in whom was found the afore-mentioned extrinsic

mass deforming the stomach that was seen during gastroscopy. Four patients had no pathologic changes other than the hepatic tumor. Vascular tumors were not found elsewhere in any of the patients.

The tumors consisted histologically of cystic spaces filled with blood and lined with endothelial cells (Fig. 2a). These spaces were separated by varying amounts of fibrous connective tissue. Sometimes the tumor exhibited regressive changes, with increased fibrosis obliterating some of the capillaries. These have been called "sclerosing hemangiomas" (Fig. 2b). The surrounding parenchyma was normal.

Treatment. Excision of the tumor was done in 4 patients, biopsy alone in 3, irradiation in 2, and partial excision and packing in 1 patient, who died 15 hours after operation. The surgical procedures used consisted of enucleation of the tumor by means of the finger in 1 patient, excision with the cautery in 1, and sharp dissection in 2. The eleventh patient had multiple large tumors; 1, which measured 15 centimeters in diameter, was excised but another and larger tumor could not be removed and the patient subsequently received roentgen therapy.

Nine patients in group A have been followed for periods ranging from 3 to 18 years, with an average of 9 years. Of the 4 whose tumors were excised, 3 are living and well without recurrence and 1 died 8 years after operation of unknown causes. The 3 patients who received irradiation, including the 1 who had 1 large tumor removed surgically, followed by roentgen therapy for other tumors, are living and well; the tumors are smaller but persistent. One patient died after operation, as already mentioned. Two patients who had only biopsy have not been heard from.

GROUP B: TUMORS FOUND INCIDENTALLY

The 24 patients in whom hemangiomas of the liver were found incidentally at operation included 19 women and 5 men. The average age of these patients was 53. 8 years, the oldest being 75 and the youngest 34. The tumors

FIG. 1. Case 7. Gross appearance of a large lobulated cavernous hemangioma of the liver.

were small, averaging 2.4 centimeters in diameter, the largest being 5 centimeters. Eleven involved the right lobe and 7 were in the left lobe, whereas 4 were multiple; the location of the remaining 2 tumors was not mentioned. There were no clinical or laboratory manifestations of the tumors and all were excised except 2, which were subjected to biopsy only. These tumors were identical histologically to the larger tumors in group A.

The primary pathologic condition for which these patients were operated on was gallstones in 13 instances, peptic ulcer in 4, carcinoma of the stomach in 2, and carcinoma of the colon, leiomyoma of the jejunum, an appendiceal abscess, an ovarian cyst, and endometriosis in 1 each. These small tumors were excised in many instances to rule out the presence of a metastatic lesion.

Sixteen patients in group B have been followed for periods of 1 to 29 years, with an average of 11 years. One patient had had an angioma of the liver excised elsewhere 12 years previously. Four patients had multiple small hemangiomas that were not removed; 3 of these have been followed for 4, 5, and 6 years, respectively, without evidence of recurrence.

COMMENT

This experience with hemangiomas of the liver is similar to that of other investigators.

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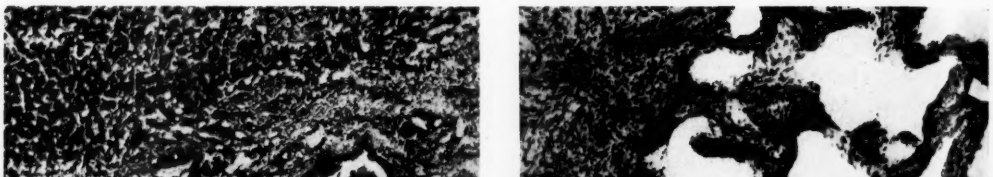

a b

FIG. 2. Histologic appearance of hepatic hemangiomas. a, Case 6. Note cystic spaces lined with endothelium and filled with blood. Normal hepatic cells are seen above. Hematoxylin and eosin, ×63. b, Case 3. Sclerosing hemangioma showing increased fibrosis and obliteration of some of the endothelial-lined spaces. Hematoxylin and eosin, ×74.

Geschickter and Keasbey found that hemangiomas involved the liver more frequently than they did any other organ. As already noted, they are found frequently at necropsy or as incidental lesions at operation, but they rarely produce symptoms. Female patients are affected more often than are male patients, the ratio being 5:1 for our entire group and 10:1 for the patients who had symptoms caused by these tumors, which is somewhat higher than the ratio in other reported series. Ayres and Amorin found the incidence to be greater in men. In general, the incidence of hemangioma of the liver increases with age, although these lesions have been described in newborn infants and young children. The average age of the symptomatic patients is about 45 years.

The size varies from that of microscopic lesions to huge tumors filling the entire abdomen. The largest one on record was the afore-mentioned tumor reported by Major and Black, which weighed almost 40 pounds. The largest one that has been resected was that reported by Pfannenstiel, which weighed 5,290 grams. The right lobe was involved more often than the left in our series, but in the case reports collected from the literature by Shumacker, the left lobe was involved 30 times and the right 18 times.

The symptoms consist of a mass in approximately half of the patients and upper abdominal distress in the other half, including vague aching pains, fullness, belching, and, in some cases, vomiting. A palpable mass is found in almost all patients.

Laboratory aids are of little assistance in diagnosis, since hepatic function is usually unaffected. Roentgenograms are frequently of value and show a soft tissue mass or displacement of the kidney, stomach, or diaphragm.

The diagnosis is rarely made preoperatively. It was made but twice in Shumacker's collected series. In our series, it was not made in any patient who had not been previously operated on, although a hepatic tumor was suggested in 2 patients.

The treatment of these tumors depends on their size and site, and to some extent on the experience of the surgeon. Excision with a rim of normal hepatic tissue is the treatment of choice, since they tend to become gradually larger and since the danger of spontaneous rupture is very real, as reported by Caldwell. Biopsy should not be done unless the surgeon is prepared to resect the tumor because it is often extremely difficult to control bleeding and death has occurred as the result of hemorrhage after mere aspiration of

the tumor, as in the case reported by Mantle. The surgeons experienced difficulty in controlling the bleeding after biopsy in several patients in the present series. If the tumor is large or if the surgeon is not experienced in hepatic surgery, he would do well to consider irradiation. Three of the lesions in our series were treated by roentgen rays; the size of the tumor was reduced or its growth was arrested in each instance. These 3 patients have been followed for 12, 7, and 4 years, respectively, and all were well when last heard from. Two had received additional courses of roentgen therapy. This coincides with the experience of Ray as well as of others.

SUMMARY AND CONCLUSIONS

A review has been made of the records in 35 cases of hemangioma of the liver encountered in patients undergoing surgical exploration at the Mayo Clinic from 1907 to 1954, inclusive. Eleven patients were operated on because of clinical manifestations thought to be the result of the tumor, whereas the hemangioma was found incidentally at operation in the remaining 24 patients.

When symptoms are caused by these tumors, they usually consist of pain produced by the size and weight of the tumor or of manifestations of pressure on adjacent organs, such as the stomach, colon, or kidney. A palpable mass is found in almost every instance.

Roentgenograms show a soft tissue mass or displacement of adjacent viscera in a significant number of cases.

Hepatic function, as determined by values for serum bilirubin and retention of sulfobromophthalein, is not often altered to a significant degree.

The presence of a benign hepatic tumor may be suggested by the clinical features but the diagnosis is rarely made preoperatively.

Ideally, the treatment would be total excision with a rim of normal hepatic tissue but experience suggests that certain inoperable hemangiomas may be controlled effectively by repeated courses of roentgen therapy.

Since severe and even fatal hemorrhage may follow biopsy or even aspiration of such tumors, these procedures should not be done unless the surgeon is prepared to resect the tumor.

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TRANSTUBAL SPREAD OF TUMOR CELLS IN CARCINOMA OF THE BODY OF THE UTERUS

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WHETHER THE TREATMENT of carcinoma of the body of the uterus is surgical or radiologic, or a combination of the two, a number of patients die of the disease within a few years of being treated.

By postmortem examination of 64 patients with endometrial carcinoma, Henriksen has observed that in most cases death is ultimately caused by uremia or pyelonephritis and that the metastases are most frequently localized to the peritoneal cavity. As to the localization of the metastases, this is in accordance with Finn's observations on clinical material. Finn studied the times and sites of recurrences of endometrial carcinoma in 49 patients, and called attention to the fact that 85 per cent of the patients had recurrences within 3 years of the initial treatment, and that the most common sites of recurrences were the remaining pelvic organs, the vagina, the bladder, the ureters, the pelvic lymph nodes, and the pelvic peritoneum.

We do not know exactly the pathogenesis of the peritoneal metastases in spite of a great number of papers on the subject. We know that endometrial carcinoma may metastasize through the lymphatics, the blood stream, or the fallopian tubes, but we do not know how often these different routes are responsible for the spread of the tumor.

It has generally been assumed that the lymphatic spread of endometrial carcinoma is very frequent and that the lymphatics are the principal route for the different metastases in the peritoneal cavity, while blood-borne metastases are fairly rare and are usually encountered in the lungs and bones. As to the frequency of the transtubal route of spread, however, there is very little agreement.

Theoretically, fragments of endometrial carcinoma may pass through the lumina of the fallopian tubes and cause implantations in the peritoneal cavity. Several cases of endometrial carcinoma with a superficial metastatic involvement of the ovary have been reported in papers by Sitzenfrey, Schiller, Norris and Vogt, and others; and in some of these cases free carcinomatous cells have been observed in the lumen of the fallopian tubes. Sampson, in a series of reports, favors the opinion that the role of transtubal metastases from endometrial carcinoma to the peritoneal cavity is of more than theoretic interest. He has reported several cases of tubal or ovarian metastases which he considers due to implantation of carcinomatous cells carried from the uterus by way of the tube; and in consequence of this he advises ligation of the fimbriated ends of the tubes before performing the hysterectomy. In Willis's opinion, "so real is the risk of transtubal metastasis from fundal carcinoma, that the surgeon performing hysterectomy for this disease should (a) make a special search for early metastatic nodules seeded on the ovaries, fimbriae or neighbouring peritoneum, discovery, of which will decidedly affect prognosis, and (b) exercise all possible care during the operation to avoid undue pressure on the uterus and the tubes, so minimizing the risk of expressing fragments of growth from the tubes into the peritoneal cavity."

On the other hand, Novak has questioned the importance of transtubal implantation and suggested that the cases reported by Sampson (8) of supposed implantation cancer of the ovary are far more logically ex-

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plained as due to lymphatic dissemination. In discussing the work of Sampson, Novak says, "from what has been said in this paper, it need scarcely be added that I do not feel convinced of the value of Sampson's recommendation to ligate the tubal ends in all cases in which a cancerous uterus is to be removed, or the wisdom of his advice to abstain from preliminary curettage except in very doubtful cases. As regards the first of these procedures, it is of course hard to find fault with any bit of technic which adds in even the slightest degree to the safety of any operation. Whether valuable or not, there is certainly no harm in this procedure, and it is possible that future investigation will show that it has a very definite value. From the evidence thus far available, however, I question whether this operative step will improve our operative results very materially, except of course where there is associated tubal cancer. Here it would seem to be a valuable means of preventing a squeezing out of cancer material from the tube. In the ordinary case, in which the tubes are perfectly normal, the value of tubal ligation will not be great."

Lynch and Dockerty state: "It is interesting to note that in many texts the advisability of performing curettage of the uterus, followed by implantation of radium in cases of carcinoma of the uterine fundus, is questioned because of the danger of disseminating carcinomatous cells through the fallopian tubes." On the basis of a study of several cases of carcinoma of the uterine fundus at the Mayo clinic, they conclude that from a practical standpoint there appears to be little risk of the production of ovarian or abdominal implantation in curetting a uterus which is the site of a malignant lesion, prior to the insertion of radium. Norman has performed hysterosalpingography upon 128 patients with carcinoma of the body of the uterus and concludes that the risk of spread of the tumor is apparently only theoretic; he has observed no tubal passage in 69 cases of the patients examined. That it may be difficult to prove by hysterosalpingography that a patient has functioning tubes is, however, pointed out by Williams, and it may be that the observations made by this method are not therefore always quite reliable. As to the risk of spread of the tumor, Stanley Way advises against attempting to diagnose endometrial carcinoma by radiography employing intrauterine injections of radio-opaque materials.

TABLE I.—CYTOLOGIC EXAMINATION OF SMEARS FROM TUBES AND DOUGLAS CUL-DE-SAC IN 21 PATIENTS WITH CARCINOMA OF BODY OF UTERUS

Source of smears			*Tumor cells, No. of cases*
Douglas cul-de-sac			7
One or both tubes			11
Unilateral		6	
Right tube	1		
Left tube	5		
Bilateral		5	

In 1 case the left tube had been extirpated at an earlier operation.

Most of the facts on the frequency of transtubal spread of endometrial carcinoma are based on macroscopic and microscopic examinations of the tubes and the ovaries in surgical specimens. Cytologic examination of wash smears from the tubes and the peritoneal cavity has, so far as I know, never been used in studying the spread of tumor cells in carcinoma of the body of the uterus. The present writer considered that such an examination might give information about the spread, and requested the Pathological Department of the Norwegian Radium Hospital to prepare such smears and look for tumor cells.

Twenty-one patients with carcinoma of the body of the uterus were operated upon by performing an abdominal total hysterectomy and bilateral salpingo-oophorectomy.

TABLE II.—AGE OF 7 PATIENTS WITH CARCINOMA OF BODY OF UTERUS AND WITH TUMOR CELLS IN THE DOUGLAS CUL-DE-SAC

	Age at menopause, years	*Age at diagnosis, years*
1	No menopause	53
2	54	55
3	46	57
4	59	79
5	54	56
6	54	68
7	50	56

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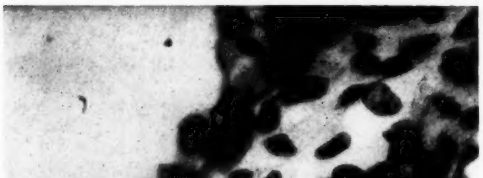

FIG. 1. Tumor cells in the Douglas cul-de-sac. ×392.

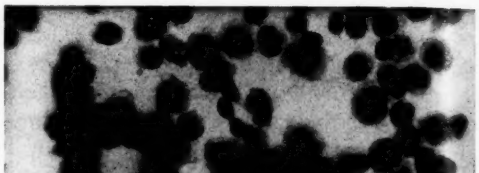

FIG. 2. Tumor cells in the Douglas cul-de-sac. ×392.

In 20 cases the surgical specimen showed adenocarcinoma; in 1 case there was an adenocarcinoma with squamous metaplasia. No metastases to the tubes or the ovaries were observed in 20 cases, while in 1 case metastases were seen in the left tube and in both ovaries. In no case was there a penetration of the tumor to the peritoneal surface of the uterus.

As to the patency of the tubes, in no case was there a bilateral occlusion. In 6 cases the occlusion was unilateral, and in 15 cases both tubes were open.

Wash smears and direct smears from the tubes, and wash smears from the Douglas cul-de-sac, were prepared in all the cases. Just after opening the abdomen, the intestines were packed away from the pelvic cavity with gauze pads, clamps were vertically applied at each side of the fundus of the uterus to the broad ligament, and the uterus pulled forward toward the symphysis. Then the Douglas cul-de-sac was washed with 20 milliliters of physiologic saline solution. Before performing the hysterectomy, the tubes were removed, and the washing and the tubes were immediately sent for cytologic examination. The result is given in Table I.

In 6 cases with tumor cells observed in smears from the Douglas cul-de-sac, tumor cells were also observed in one or both tubes. In 1 case the smears from the tubes were negative.

Novak found that out of 7 patients with ovarian extension of uterine cancer only 2 were of menstruating age. This would seem, Novak says, "to speak against the theory of Sampson that regurgitated menstrual blood may easily carry with it cancer particles that reach the ovarian or peritoneal surface and implant themselves." In this connection it is interesting to note that 6 of the 7 patients included in the present material demonstrating positive smears in the Douglas cul-de-sac were beyond the menopause (Table II).

This, then means that retrograde transportation of cancer cells through the tubes does occur in spite of the fact that we are dealing with senile fallopian tubes. However, a certain proportion of women in the menopause retain what appears to be normal tubal contractility, as pointed out by Rubin.

When free tumor cells or clumps of such cells are seen in the Douglas cul-de-sac it must be assumed that they may also spread to other parts of the peritoneal cavity. We do not know if these cells are viable and capable of causing implantation of the peritoneum, but, bearing in mind the frequency of intraperitoneal metastases, we may regard them as a possible etiologic factor in the development of metastases. Consequently, our treatment must aim at destroying them.

Andrews, Root, Kerman, and Bigelow, in their article on intracavitary colloidal radiogold in the treatment of effusions caused by malignant neoplasms, state that the prophylactic use of radiogold in patients who have no known metastases, but who have lesions which are considered likely to spread to the peritoneum, may be worth consideration. In the last 2½ years prophylactic radiogold treatment has been used at the Norwegian Radium Hospital on some patients with carcinoma of the ovary when a carcinomatous ovarian cyst had ruptured into the peritoneal cavity during operation. The patients were reoperated on, the remaining uterus and ovary were extirpated, and, just before closing the abdomen, the peritoneal cavity was filled with 1½ liters of physiologic saline solution. On completion of the operation, about 100 millicuries of radioactive colloidal gold, Au^{198}, were introduced through a catheter into the artificial abdominal fluid. The catheter was left in the abdomen, thus making it possible to inject more saline solution if the distribution of the gold should seem unsatisfactory. The distribution was controlled by autoradiography and by measuring the gamma radiation by means of a Geiger counter. Since we have observed no harmful effects from this treatment, and since, owing to the intraperitoneal spread of tumor cells in carcinoma of the body of the uterus, the treatment seems justified, we have in the last year given a prophylactic intraperitoneal colloidal radiogold treatment to 9 patients with this disease. In some cases we have seen symptoms taking the form of nausea, vomiting, and diarrhea, but in no case has depression of hematopoiesis been observed. All the patients were given the usual postoperative radiotherapy (radium in vagina and deep x-ray therapy).

It is impossible at the present time to say anything conclusive about the effect of this therapy, but the treatment seems logical and justified if we wish to minimize the possible risk of implantation of free tumor cells in patients with carcinoma of the body of the uterus.

SUMMARY

Twenty-one patients with carcinoma of the body of the uterus were operated upon by performing an abdominal total hysterectomy and bilateral salpingo-oophorectomy. Wash smears and direct smears from the tubes, and wash smears from the Douglas cul-de-sac, were prepared in all the cases. By cytologic examination tumor cells were observed from one or both tubes in 11 patients (6 unilateral and 5 bilateral cases) and from the Douglas cul-de-sac in 7 patients. In 6 cases with positive smears from the Douglas cul-de-sac tumor cells were also observed in one or both tubes. When free tumor cells or clumps of such cells are seen in the Douglas cul-de-sac, it must be assumed that they may also spread to other parts of the peritoneal cavity. We do not know if these cells are viable and capable of causing implantation of the peritoneum, but, bearing in mind the frequency of intraperitoneal metastases, we may regard them as a possible etiologic factor in the development of metastases. Consequently, our treatment must aim at destroying them. For this purpose, we have in the last year given a prophylactic intraperitoneal radiogold treatment to 9 patients operated upon for carcinoma of the body of the uterus. Just before closing the abdomen, the peritoneal cavity was filled with 1½ liters of saline solution. On completion of the operation, about 100 millicuries of radioactive colloidal gold, Au^{198}, were introduced through a catheter into the artificial abdominal fluid. Since we have observed no harmful effects from this treatment, it seems to be justified if we wish to minimize the possible risk of implantation of free tumor cells in patients who have carcinoma of the body of the uterus.

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EVALUATION OF PELVIC EXENTERATION FOR ADVANCED CANCER OF THE CERVIX

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THIS IS A PROGRESS REPORT. Since September 1947, pelvic exenterations have been performed on the senior author's service in 441 cases for various forms of advanced pelvic cancer (Fig. 1). The diagnoses in these patients are presented in Table I. A previous over-all report was published in 1954 (3). These figures do not include a few posterior exenterations which left the urinary tract intact. Most patients presented advanced carcinoma of the cervix.

The results in cases of carcinoma of the cervix *only* will be considered herein. In the majority of instances the patients presented recurrent cancer, failures of previous treatment. Ninety-three (27 per cent of the series) had not had previous treatment. The previous treatments, if any, are summarized in Table II.

Of the 336 cases of carcinoma of the cervix in which either complete or anterior pelvic exenteration was performed, 93, or 27 per cent as stated, were fresh cases. Most of these were classified as either League of Nations stage III or stage IV. In the past 2 or 3 years, more anterior exenterations have been performed for the League of Nations stage II cases in the presence of actual parametrial involvement and encroachment on the bladder or ureter. This small group of fresh cases represents roughly 20 per cent of all fresh cases of carcinoma of the cervix operated on during this period of time.

Three groups of patients had definitive surgery with or without irradiation—one group, surgery alone; another, relative conservative surgery for recurrences following attempt at cure with irradiation; and another, relatively conservative surgery followed by irradiation for recurrence. In these three groups of patients, there were 26 cases of our own surgical failures, most having had hysterectomy and pelvic node dissection.

Fifty-three patients had had a simple hysterectomy done elsewhere as a part of their treatment; simple total hysterectomy should not be performed for infiltrating carcinoma of the cervix. Also of interest are the 15 cases treated by subtotal hysterectomy elsewhere. The cancer was diagnosed at that time or shortly thereafter when the pathologic specimen was studied. The performance of subtotal hysterectomy in the presence of cancer of the cervix indicates failure to have diagnosed the lesion preoperatively.

The indication for exenteration procedures has depended on the extent of disease present and not on the type of previous treatment. The latter is of no importance in deciding to operate. In the past few years we have had an increasing inclination to perform a more radical procedure in instances in which there was encroachment upon, without actual invasion of, the bladder or rectum. The early results in this group of patients have been encouraging.

TABLE I.—DIAGNOSIS

Diagnosis	*No. of cases*
Carcinoma of cervix	336
Carcinoma of corpus	32
Carcinoma of vulva	21
Carcinoma of rectum	17
Carcinoma of vagina	10
Sarcoma uterus	10
Carcinoma of ovary	10
Others	5
Total	441

From the Memorial Center for Cancer and Allied Diseases, New York.

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TABLE II.—PREVIOUS TREATMENT IN 336 CASES

Treatment	*No. of cases*
None	93
"Curative" irradiation only	145
Surgery only	26
Total hysterectomy 10	
Schauta hysterectomy 2	
Hysterectomy and nodes 14	
"Curative" irradiation followed by surgery	22
Total hysterectomy 14	
Hysterectomy and nodes 7	
Posterior exenteration 1	
Surgery followed by irradiation	35
Total hysterectomy 29	
Wertheim hysterectomy 4	
Hysterectomy and nodes 2	
Subtotal hysterectomy within 3 years	15
No irradiation 4	
Followed by irradiation 11	

The selection of patients for the exenteration procedures has been minimal and, as stated before, depends more on the extent of the disease than upon anything else. These operations are not now performed unless the cancer is limited to the pelvis and can be completely removed. No patients with distant metastases or indurated, painful, and swollen legs are now being subjected to laparotomy.

In the earlier phases of this program, patients were not infrequently operated upon for palliative purposes only. In these instances, disease was sometimes left behind of necessity. The results were poor. It is now our decision not to attempt exenteration unless previous exploration at laparotomy indicates that all macroscopic evidence of disease can be removed. The results in 36 cases in which disease obviously was left behind at operation are shown in Table III.

Other important factors to consider in operating upon patients by this type of surgery are the general medical condition of the patient, i.e., obesity, age, location of home, and the mental status of the patient. It is indeed difficult to establish rules regarding who should have this operation, and each patient must be carefully considered individually as no two are similar. For example, radical vaginal excision (Schauta) operations (2) were carried out initially in some patients because they were deemed bad surgical risks. Yet, when recurrences occurred in some of them, total exenterations were done, and the patients withstood the operations very well. Should they have had radical hysterectomy and pelvic node dissection initially? Most important features in preoperative evaluation are the mental status of the patient, the home situation, and the attitude of the family. Of importance also, is the distance of the patient's home from the hospital or supervising physician. If the patient lives far from adequate and sympathetic medical supervision, great hesitancy must be exercised in performing the operation.

TABLE III.—RESULTS AFTER GROSS CANCER LEFT AT OPERATION

	No. of cases
Total	36
Surgical mortality	12
Dead of recurrences	35
Living (with cancer—4 mos.)	1

Average survival, 3+ mos.
Longest survival, 16 mos.

Table IV summarizes the yearly experience. The surgical mortality—that is, death within 30 days—for the over-all group was 16 per cent. For the complete exenterations it was 19 per cent and for the anterior, 11 per cent. Since 1950 the mortality in 86 consecutive anterior exenterations was about 6 per cent. Instead of a decrease in the number of anterior exenterations, there has been a slight increase in this group as more have been performed for the League of Nations stage II cases with lateral spread or recurrences with indefinite vesical and ureteral margins. There has also been an increase in number of complete exenterations in patients having encroachment on, but not actual involvement of, the rectum.

The causes of immediate operative mortality, death within 30 days are summarized in Table V. The chief cause of death, despite advances in blood transfusion therapy, has been surgical shock. Most of those dying of shock—14 of the 19—did so in the operating room. These patients represented the worst cases, that is, recurrences; and many did have disease left behind. Many of them developed a bleeding syndrome occurring anywhere after infusion of 8 units of blood,

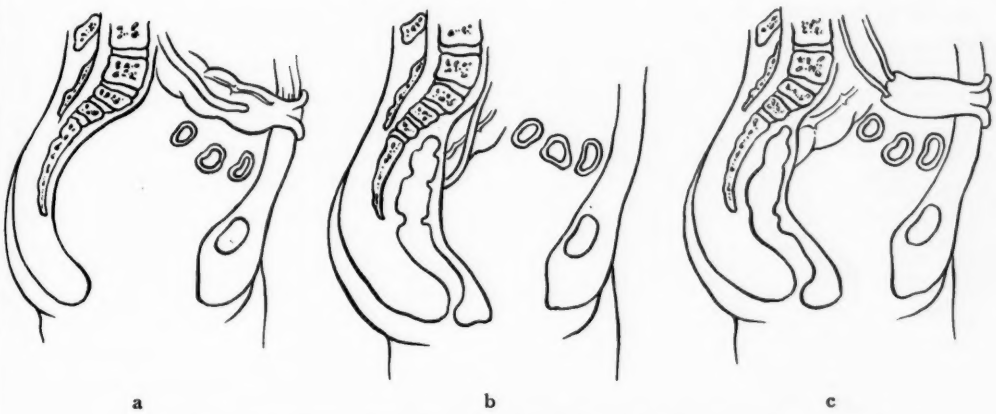

FIG. 1. Showing various types of pelvic exenteration. a, Total pelvic exenteration with wet colostomy. b, Anterior pelvic exenteration with bilateral ureterocolostomy in intact colon. c, Anterior pelvic exenteration with ileal bladder. Ureters threaded into proximal end of ileal segment.

which, as yet, represents one of the chief problems to be solved. Other patients had cardiac arrest, some with ventricular fibrillation, possibly due to a change in the serum electrolytes because of the rapid turnover of blood. Most of the cases of peritonitis and sepsis occurred in the early part of the program before the newer antibiotics were available. Four of the 6 patients expiring in uremia probably had lower nephron nephrosis; 2 of these were proved at autopsy. Small bowel fistula is still a serious complication and is the chief cause of death in the hospital after 1 month.

The extent of carcinoma as determined by study of the pathologic specimens has been tabulated in all of these patients. The most significant finding in the pathologic study has been the presence or absence of pelvic node metastases. These results are shown in Table VI.

Of 100 cases of pelvic exenteration followed 5 or more years, 12 of 67 patients (18 per cent) are living who had negative lymph nodes. In the positive node group, there has yet been only one 5 year survivor. These results are quite different from those obtained following radical hysterectomy and pelvic node dissection for cases with positive nodes in stages I and II. In a study of the latter there was a 30 per cent 5 year survival rate among 43 patients (unpublished data).

TABLE IV.—YEARLY EXPERIENCE WITH PELVIC EXENTERATION FOR CARCINOMA OF THE CERVIX (SEPTEMBER 1947 TO JANUARY 1956)

Year	Total No.	Complete exenteration	Anterior exenteration	Surgical mortality (within 30 days) Complete exenteration	Surgical mortality (within 30 days) Anterior exenteration	Living Complete exenteration	Living Anterior exenteration
1947	10	5	5	0	0	0*	1
1948	39	26	13	6	6	3	1
1949	30	17	13	4	2	2	1
1950	32	21	11	1	1	3	4
1951	36	26	10	3	0	3	1
1952	45	31	14	6	0	7	3
1953	48	32	16	9	2	5	6
1954	51	33	18	8	1	14	9
1955	45	28	17	5	1	17	13
Total	336	219	117	42	13	54	41

Included are 17 patients with irradiation necrosis at time of operation, but 2 died subsequently of cancer.
*One patient with extensive persistent radiation necrosis lived 7 yrs. 9 mos. and died of complications not associated with recurrent cancer or the initial total exenteration. The 7 yr. pyelograms were normal.

TABLE V.—CAUSE OF SURGICAL MORTALITY

	No. of cases
Surgical shock (O.R.—14)	19
Peritonitis	7
Generalized sepsis	6
Uremia (lower nephron nephrosis, 4)	6
Intestinal fistula	5
Pulmonary embolism	2
Cerebral accident	2
Gastrointestinal obstruction	1
Late hemorrhage	1
Pneumonia	1
Hepatitis	1
Unknown	4
Total	55

One hundred and eleven patients have been followed 5 or more years, and the 15 per cent survival here obtained certainly compares most favorably with the results obtained in treating *advanced* carcinoma of the esophagus, lung, stomach, and pancreas.

Details as to the experience with varying methods of urinary tract diversion are beyond the scope of this paper, but some data have been published (4). The wet colostomy in the complete exenteration group has been quite satisfactory, and no change is anticipated. This type of diversion has been easy to perform, has had a low immediate morbidity and mortality, and is compatible with a comfortable, long survival. Bag prostheses allow full activity.

Ureteral transplants into the colon above an intact sphincter in the anterior exenteration group have been gratifying in approximately half the cases. In the remainder, there have been serious, and sometimes even fatal, complications. The incidence of hyperchloremic acidosis, pyelonephritis, and progressive deterioration of kidney function has been higher than in the wet colostomy group. We are in the process of evaluating in our hands the use of the ileal bladder described by Bricker in both types of exenteration operations (total and anterior), but especially in the anterior exenterations. Our initial impressions of the ileal bladder are favorable but there are special complications that may ensue in the performance of this procedure.

Cutaneous ureterostomies are not performed as an elective procedure. This form of diversion of the urinary tract is the simplest and rapidly affords satisfactory pyelograms. However, it gives the patients with total exenterations 3 stomas and those with anterior exenterations, 2 stomas. Frequent personal supervision by the physician is necessary. We have resorted to this form of diversion in some instances, i.e., those in which rapid termination of the operation was mandatory or short remaining ureters were present. We have had some good results in such patients but, as stated, do not carry out the procedure as a first choice elective one.

TABLE VI.—LYMPH NODE STATUS IN 5 YEAR SURVIVORS

	No. of cases	*Surgical mortality*	*Living*
Negative nodes	67	8	12
Positive nodes	33	10	1
Total	100	18	13

Does not include patients with irradiation necrosis.

TABLE VII.—SURVIVAL AFTER PELVIC EXENTERATION

Years	*No. of cases*	*Per cent surgical mortality*	*Per cent survival*
5	111	18.0	15.3
3	192	15.1	22.9
1	291	16.9	44.7

DISCUSSION AND CONCLUSIONS

In order to evaluate pelvic exenterations more accurately, it is necessary to consider these procedures separately in relation to one form of cancer, i.e., of cervix, corpus, or rectum. Such a report has been published by Parsons.

Statistics have a limited significance because of the number of variables that may enter into the study in question. For example, if the surgeon selects his patients carefully and envisages "cure" only, the results will be different than if minimal selection is followed and palliation is envisaged as well as cure. This, however, does not alter the fact that the exenteration operations would now seem to be established procedures capable of offering benefit to patients with advanced pelvic cancer, including especially those with recurrences following failure of radiation or more conservative forms of surgery. It goes without saying that the best re-

sults are to be expected when the disease is actually confined to the midportion of the pelvis and regional lymph nodes are still free from metastases.

As has been stated before, these operations were initially undertaken for palliation only. No "cures" were expected at first. This palliative objective continues to be envisaged since a 22.4 per cent 3 year survival rate was achieved. That a 5 year survival can be offered is attested to by a 15 per cent incidence in 111 minimally selected patients who had pelvic exenteration operations.

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FACTORS INFLUENCING THE SPREAD OF CANCER

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THE TWO POPULAR THEORIES of the spread of cancer place different emphases on the importance of the passage of time. The most widely supported theory is the classical concept that cancer starts as a localized disease, spreads as time passes to the regional lymph nodes, and with further passage of time spreads throughout the body (Fig. 1). The second is the theory called by Ian MacDonald "biologic predeterminism," which holds that each cancer has certain biologic characteristics which tend to remain more or less constant throughout its life (Fig. 2). In this concept it is the type of tumor and the resistance of the host that largely determine the spread of cancer. From the point of view of biologic predeterminism the factor of time is less important, for it is thought that by the time cancer can be recognized clinically it is apt already to have metastasized if it is capable of doing so.

It is not possible to prove or to disprove that either one of these concepts affords a complete explanation of the spread of cancer. But in some kinds of cancer, like those of the skin, we have learned that the factor of time is not so important as is the type of cancer and its biologic behavior. A basal cell cancer of the skin rarely metastasizes to lymph nodes regardless of how long it is left untreated; a squamous cell cancer of the skin usually metastasizes only to lymph nodes and rarely metastasizes systemically; and finally a melanoma may metastasize systemically even before the primary tumor is noticeable. We distinguish between these three types of cancer of the skin and recognize that even with the passage of time each of these cancers tends to remain true to its type and does not change from one type to another type (Fig. 3).

Cancers of the thyroid, like cancers of the skin, can be separated into biologic types. Some types, like the papillary carcinomas, tend to remain localized or to metastasize only to the regional lymph nodes, whereas others, like the angio-invasive cancers, rarely metastasize to lymph nodes but tend to metastasize widely through the blood stream. Here again there is little likelihood that a localized or lymph node metastasizing papillary carcinoma which has not metastasized systemically will change its pattern of behavior and spontaneously give rise to systemic metastases. These cancers, like those of the skin, tend to run so true to their biologic type that usually their clinical behavior can be predicted.

Since we know much less about cancers of the internal organs than we do about those of the skin and the thyroid, there is at present no certain way of telling whether the various types of cancer of the stomach are as distinct from one another, in their biologic types, as are the various types of cancer of the skin. Perhaps there are cancers of the stomach that remain localized indefinitely, others that metastasize only to regional lymph nodes, and a third group that, like the melanoma, spreads systemically even before the primary tumor can be recognized. Pathologists cannot as yet differentiate between the different biologic types of cancer of the stomach, and clinicians, therefore, cannot predict their courses.

In interpreting the clinical behavior of cancers of the stomach and internal organs, it is easy to apply the classic concept of the spread of cancer and to assume that it is the passage of time that causes a localized disease to become systemic. It is easy to assume

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that a localized cancer of the stomach is a young cancer that has not been present long enough to spread, and that a diffusely metastasizing cancer is an old cancer that has been present long enough to allow it to metastasize. Yet in individual cases we know that primary cancers of the stomach which have given rise to systemic metastases may be so small that they are not recognizable on gross examination and that large cancers of the stomach, known to be present for several years, are often localized. The concept that time determines the spread of cancer cannot be defended in each individual case. The question is: How important *is* the factor of time in determining the systemic spread of various cancers?

If the time between the appearance of the first sign or symptom and the beginning of treatment were the main factor in influencing the fatal course of the disease, and if this fatal course could be influenced by early and wide excision of the tumor, one might expect that our present program, with its emphasis on early and wide excision, would have shown promise of controlling the death rate from cancer.

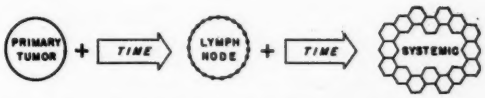

FIG. 1. Conventional concept of the spread of cancer. In this concept the disease progresses, with the passage of time, from a localized to a disseminated stage. The widest possible operation performed at the earliest possible time would give the best chance of cure.

FAILURE OF EARLY AND RADICAL TREATMENT TO ALTER THE DEATH RATE FROM CANCER

Prior to 1930 the vital statistics on deaths from cancer were not well tabulated. But since 1930, during the period in which the maximum effort has been made to educate the public in early diagnosis and to train the profession in radical excision, accurate statistics have been collected. Unfortunately, the statistics during this period show that there has been no decrease in the rate of death from cancer. Even when allowance is made for the increasing age of the population, there has been a slight increase in the age-adjusted death rate: 113.4 per 100,000 in 1930 as compared to 120.9 in 1945. Cancer of the breast, the prime target of educational campaigns, is killing as many people as ever. Even in Connecticut where a comprehensive organization for cancer control has been in existence since 1932, the age-adjusted death rate from cancer of the breast per 100,000 people rose from 30 in 1937, to 37 in 1948. Nor has there been any reversal of this trend in more recent years.

The lack of correlation between cancer death rates and cancer-control programs has been reported by McKinnon of the School of Hygiene in the University of Toronto (19, 20). McKinnon states that in those provinces of Canada which have socialized cancer-control programs and in which all the people are given free diagnostic services and free treatment for cancer, the introduction of these programs has not decreased the age-adjusted death rate from cancer. The death rate from cancer is no lower in the provinces which have cancer-control programs than it is in those which have none. The observations suggest that the increase in the rates of cure of some cancers may result from the inclusion of a large number of cancers that would not have been fatal even if untreated. Cancer in situ in rectal polyps of older people is an example. As McKinnon has said, the mortality rate from cancer is not affected by curing cancers that would not have caused death even had they remained untreated.

P. F. Denoix, chief of the technical services of the Cancer Department of the National Institute of Hygiene of France, has come to the same conclusion from a careful statistical study of 33,784 observations on the courses of various cancers treated in the hospitals of Paris. Of cancer of the breast, Denoix said: "The duration between the first sign of the disease and the institution of treatment has decreased because those affected have become more worried than previously—so that diagnosis has been effected earlier. However,

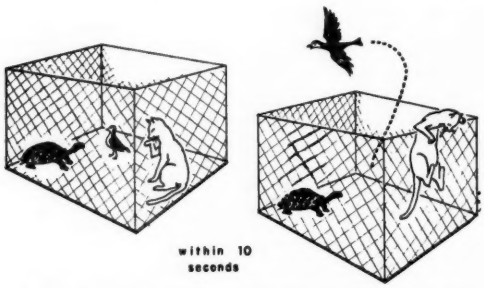

FIG. 2. Concept of biologic predeterminism applied to the spread of cancer. In this concept each cancer is a biologic entity, like an animal, with its own pattern of behavior that does not vary within its span of life. Resistance of the host can be likened to the cage within which various types of cancer cells are contained. Delay in treatment is less important because those cancer cells that are able to escape from the cage are apt to do so before the cancer can be detected. Within wide limits the extent of the operation could not be expected to alter the results, because those cancer cells that are capable of escape are apt to be disseminated far and wide in the body.

this reduction of the mean duration has not led to an increase in the number of tumors locally less extensive, and in toto the reduction of duration has not altered the prognosis. . . . We have not found any systemic relation between the duration and prognosis. . . . The recovery rates observed in the treatment of cancers, viewed as a whole, have been stationary for several years. For each localization the results obtained differ very little since treatment by surgery, radiations, or combination of the two therapeutic procedures have been put into effect by distinguished cancerologists. . . . Present day treatments do not permit the recovery of more than a certain *a priori* 'favorable' cases and we cannot say with certainty whether this is the result of our efforts or not."

There are so many pitfalls in interpreting statistical studies that conclusions based on statistics alone should not be applied indiscriminately to individual cases. Nevertheless, the failure of cancer-control programs to diminish the death rate from cancer indicates that surgery and irradiation, no matter how early or how skillfully applied, do not often prevent or permanently control metastases from highly malignant invasive cancers. It is unlikely that errors in vital statistics are responsible for this apparent failure, for vital statistics accurately reflect the progress that has been made in the control of tuberculosis, pneumonia, and other bacterial infections. If early diagnosis and radical treatment were a valid answer to the problem of cancer, a similar reduction in the death rate from cancer might have been expected.

The recent British literature and that of the Scandinavian countries contain many references to the failure of early and radical surgery to control cancer. Kreyberg and Christianson (15) reported that in a group of patients with very small "pea-sized" cancers of the breast more than two-thirds either had metastases at the time of operation or subsequently developed them. In speaking of public education about cancer Kreyberg (14) concludes: "It is not correct and not fair to publish such statistics in a manner that makes the public believe that if the women examine themselves regularly and carefully and pay a visit to a competent doctor at the first suspicion of a symptom from the breast, their chances of a complete cure are in the vicinity of 90 per cent." Bloom similarly concluded from a study of cancer of the breast in England that, "The survival rate [of patients with cancer of the breast] is uniform, no matter how long the history." Haagensen and Stout in this country also reported, "Although in our 1915 to 1934 series of cases the cure rate fell with increasing duration of the disease as would be expected, the data in the present series do not show such a correlation." The rate of clinical cure was slightly (but not significantly) higher in those of Haagensen and Stout's patients who had delayed treatment 1 to 5 months, and also in those who had delayed it 6 months or more, than it was in those who had had symptoms for less than a month before treatment.

Perhaps the most pessimistic note about the treatment of cancer of the breast is struck by Park and Lees who conclude that: "(a) It has not been proved that the survival rate of cancer of the breast, using the 5 year

survival rate as an index, is affected by treatment at all. (b) The evidence strongly suggests that treatment is quite ineffectual in reducing the incidence of death from metastatic spread. (c) If treatment is in any way effective, the effectiveness cannot be greater than that required to increase the over-all 5 year survival rate by more than 5 to 10 per cent." Small and Dutton at the University of Rochester similarly concluded from a study of cancer of the breast, "It appears that mortality in cancer is a constant process, little affected by treatment."

In the light of these studies and our daily clinical observations we should re-evaluate our program for the control of cancer and search for the causes of its failure.

SOME CAUSES FOR THE FAILURE OF SURGERY TO CONTROL THE DEATH RATE FROM CANCER

Since cancer of the breast is one of the most accessible and carefully studied of all the common cancers, it is not surprising that the operation for this cancer has been widely used as an example of the "principle of cancer surgery." Until the mid 1940's the Halsted technique of radical mastectomy, i.e., wide resection of the primary tumor in continuity with the lymphatics that drained it, went almost unchallenged as the perfect example of this principle. Yet Halsted himself, according to his former associates Lewis and Rienhoff, realized that this operation should be reappraised, and in 1932, Lewis and Rienhoff said, ". . . a large number of patients are free from *clinical cancer* for a varying number of years following operation, but whether or not a patient is ever completely cured (*in the pathologic sense*) of carcinoma is open to question. Undoubtedly, if operated upon properly the condition may be cured locally, and that is the only point for which the surgeon must hold himself responsible."

Denoix has stated this concept with equal clarity, saying: "From the moment the cancer becomes perceptible, the general and standard conception of cancer as starting from a cell, extending progressively both locally and at a distance, should be abandoned

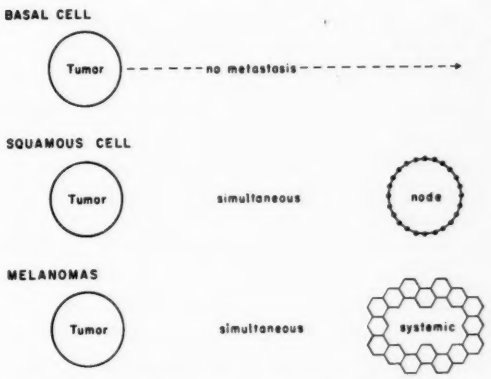

FIG. 3. Modes of skin cancer metastasis. If we view the skin as an organ it is at once clear that the skin gives rise to 3 different types of tumors each of which has a pattern of behavior peculiar to itself. The passage of time does not change a basal cell to a squamous cell carcinoma, nor is a basal cell cancer apt to metastasize regardless of how long it remains untreated. Perhaps, cancers of these 3 types are found in all organs.

and replaced by the concept of a general cancerous disorder. . . . It thus seems as though at a certain point in the development of a cancer, cells of a histologically malignant character are present to some small extent everywhere in the body. The commencement of this diffusion probably occurs before the point at which the patient perceives the first sign of cancer. When he comes for the first consultation this stage is already passed. Whatever the mechanism of this diffusion, transport through the blood, along the lymphatics, local 'induction' occurring at separate or simultaneous instants, the subject whom we are examining reacts to his general cancerous disorder and to the diffusion of the malignant cells in an individual manner which determines the form of the cancer which is diagnosed."

Support for this concept of biologic predeterminism is given by the work of Engel in Stockholm, who studied the blood from the veins that drained cancers of the colon, stomach, breast, and lung. Specimens of blood drawn from these veins during operations showed cancer cells in 59 per cent of 107 patients. Fisher and Turnbull likewise found cancer cells in the blood of 8 of 25 pa-

tients with operable cancers of the colon. Cole, Packard, and Southwick also have observed cancer cells in the blood, and Engel has found cancer cells even in blood drawn from the antecubital veins of patients with cancer. With the development of better cytologic techniques, cancer cells are being recognized with increasing frequency in bone marrow biopsies aspirated from the sternum.

Engel does not mention finding cancer cells in the blood of patients having grade I cancers, but reports finding them in 35 per cent of grade II, 78 per cent of grade III, and 100 per cent of grade IV tumors. It is interesting that in a short (3 year) follow-up, Engel noted no correlation between the presence of the cancer cells in the blood and the survival of the patients. This observation suggests that the fate of a patient with cancer is determined less by whether cancer cells have entered the blood stream than by the resistance of the host and the transplantability of the cancer. According to this concept early and wide excision of highly malignant cancers cannot be expected to prevent their systemic spread, for by the time the primary cancer can be recognized clinically, the development of metastases is largely predetermined. The survival of the patient is dependent not so much upon how early the primary tumor is excised as upon the transplantability of the tumor and the resistance of the host.

THE ANALOGY BETWEEN THE SPREAD OF CANCER AND THE SPREAD OF INFECTION

The spread of cancer cells in the body appears to be similar to that of bacteria, except that in most cases the course of cancer is slower and more difficult to observe than that of infection. McKinnon has suggested that some cancer cells are like the spirochetes of syphilis—they spread almost instantly throughout the body. Cancer cells, like motile organisms, tend to lack attachment to surrounding cells and are capable of ameboid movements. These are the qualities that cause cancers of the cervix to shed their living cells into the vagina and cause cancers to invade blood vessels and lymphatics so that cells are shed internally into the moving streams of body fluids. Removal of the primary tumor can no more deter such cancers from spreading to distant organs than excision of the chancre can prevent the spread of syphilis to the central nervous system. Whether the distant spread of the cells or organisms will result later in serious manifestations of the disease depends on the balance between the resistance of the host and the aggressiveness of the disease.

Some cancers are like hemolytic streptococcal infections, they spread at once throughout the body and may cause systemic reactions before there is a sign of the disease at the point of origin. Some cancers are like staphylococcal infections, tending to localize. But probably both staphylococcal infections and low grade cancers occasionally shower the blood with cells or bacteria, most of which fail to survive and grow. In the diseases of low virulence or when the resistance of the host is high, it is only occasionally that a metastatic abscess or tumor develops.

The regional lymph nodes are considered to be barriers to the spread of infection, and as Zeidman and Buss have shown in animals, the nodes appear also to act as a barrier to the spread of cancer. In infections we protect lymph nodes to preserve their localizing function; we rarely excise them and never manipulate them lest these excisions and manipulations break the natural barriers and spread the disease. But in the treatment of cancer the lymph node barrier, especially when it is grossly involved, has been considered to be a potential source of further spread of the disease which should at all costs be excised. No one, before the days of antibiotics, would have considered the radical removal of acutely inflamed nodes from the axilla of a patient with a hemolytic streptococcal infection of the hand. Yet today few surgeons hesitate to excise axillary nodes even if they are grossly involved by a grade IV cancer of the breast.

THE DANGER OF DISSEMINATING CANCER

The importance of the lymph node barrier. The acceptance of the principle of radical mastectomy is based on the classical theory that clinical cancer is at first a localized disease. For more than half a century this concept has stood without serious challenge. Then came McWhirter's clinical experiment which was conducted not on a selected group of patients but on a whole population group of more than a million people in the South of Scotland.

Many American surgeons have misinterpreted the significance of McWhirter's experiment and believe that he has shown only that roentgen therapy is as good as radical mastectomy in the treatment of cancer of the breast. This is not the case. McWhirter has shown that simple mastectomy plus roentgen therapy is in his hands *more* effective than radical mastectomy plus roentgen therapy. With all factors of selection eliminated and roentgen therapy given both to patients treated by radical mastectomy and to those treated by simple mastectomy, McWhirter has shown that the death rate from cancer 5 to 10 years after treatment is 10 to 15 per cent lower in the group of cases in which the lymph nodes were *not* removed. In McWhirter's own words, "The findings therefore suggest that by not dissecting the axilla the risk of dissemination of cells to distant sites is reduced."

Haagensen and Stout, in another large and carefully studied series of cases, have worked toward the same conclusion by a different route. They have repeatedly emphasized the undesirability of routine axillary dissection in the presence of advanced cancer of the breast, and have shown that when rigid criteria of operability are followed the results of radical mastectomy are excellent. The implication of Haagensen and Stout's observations is identical to that of McWhirter's; i.e., that radical operations performed for advanced cancer of the breast are neither palliative nor curative. They tend to disseminate cancer and shorten the patient's life.

The vital question that is raised by the observations of Haagensen, Stout, and McWhirter has nothing to do with the value of irradiation in the treatment of cancer of the breast. Both sets of observations suggest that there is a group of breast cancers, in which harm is done by resecting involved lymph nodes. The challenge is to learn to recognize the cancers that can be cured by radical operations and to learn to avoid radical operations in the treatment of those cancers which operations would spread. This may not be impossible.

If there are at least 3 separate types of cancer of the skin, there may be 3 or more separate types of cancer of the breast. The localized type of breast cancer which does not metastasize may be like a basal cell cancer of the skin and it may be perfectly curable by a well executed simple mastectomy. The second type may be like a squamous cell cancer of the skin or a papillary carcinoma of the thyroid. It may choose to metastasize only to regional lymph nodes and to no other part of the body. This type of cancer may be curable by complete excision of the primary tumor and its zone of lymphatic metastases. In this type a radical mastectomy, even in the presence of involved nodes, is apt to be curative and to be superior to roentgen therapy. Finally there may be a third type in which the presence of metastases in lymph nodes is, as in a melanoma, a grave sign that systemic metastases is apt to have occurred. If we could learn to recognize this all-too-common type we might employ roentgen therapy to good advantage and avoid the dissemination of tumor that may follow radical surgical attacks on the lymph node barriers.

The danger of dissemination through the blood stream. Cancer spreads through the blood stream as well as through the lymphatics. Forty-two years ago it was established by Tyzzer that massage of cancers in mice increased the incidence of metastasis to the lung from 0 per cent in the controls to 80 per cent in the massaged mice. This observation was later confirmed by Marsh and

by Knox, and recently Fisher and Turnbull's clinical studies have demonstrated that manipulation of a rectal cancer at the time of operation may shower the blood stream with cancer cells. The high incidence of metastasis to the liver 2 years after operations for cancer of the colon and the low postoperative survival rate of patients with cancers of the rectum and at the flexures of the colon, where manipulation is often necessary to deliver the tumors, raises the question of the role of operative manipulation in the production of metastases. The frequency of blood-borne metastases following operations for angio-invasive cancers of the thyroid and the tendency of these metastases to be fairly uniform in size also suggest the possibility of dissemination by surgical manipulation. These are important considerations, for it is possible that the body is able to deal with individual cancer cells exfoliated into the circulation but is not able to destroy clumps of cells liberated by trauma and causing emboli in blood vessels.

The danger of implanting cancer. Even low-grade cancers, when they are cut into or biopsied, can seed themselves in incisions. In more than half of all papillary cancers of the thyroid that had been subjected to a previous biopsy or partial removal, I have found at the time of the secondary operation carcinomatous implants in scar, skin, or muscle, remote from the primary tumor. Yet it is common practice to take biopsies of cancers of the thyroid, cancers in the peritoneal cavity, metastatic nodules in the liver, localized cancers of the pancreas, or parts of lymph nodes that might be involved by cancer. In the days before antibiotics, surgeons would not have incised a walled-off intra-abdominal staphylococcal abscess, taking no care to protect the vulnerable peritoneal cavity. Exposed cancers are constantly exfoliating cancer cells and are no less dangerous than opened abscesses. It is, therefore, not surprising that when surgeons take biopsies of or cut into abdominal cancers the incidence of carcinomatous peritonitis is high, or that many of our patients believe that cancers, if they are operated upon, are frequently spread.

Since antibiotics have been available to prepare the bowel and control bacterial peritonitis, I have observed an increased incidence of peritoneal carcinomatosis and of carcinomatous implants in incisions following resections of gastrointestinal cancers. Carcinomatous peritonitis has taken the place of the bacterial peritonitis that in the past may have killed cancer cells or the patients who bore them. Observations from the laboratory also tend to incriminate the use of antibiotics as a factor favoring the implantation of cancer. Vink injected a suspension of transplantable cancer cells into the intestine of a rabbit and then resected the intestine and re-anastomosed it below the site of resection. Recurrent cancer at the line of suture was 4 times as common in animals prepared for operation by antibiotics as in the unprepared animals.

In recent years Goligher, Dukes, and Bussey, in Britain, and Cole, Packard, and Southwick, in the United States, have called attention to the danger of implanting the cancer cells that are free in the lumen of the bowel at the time of resection of the colon. The danger of this type of implantation is illustrated in the cases reported by Beahrs, Phillips, and Dockerty in which exfoliated cells from cancers high in the colon implanted themselves in the incisions of hemorrhoidectomies. I have seen a patient who had a tiny polypoid carcinoma of the colon removed by transcolonic resection and who 3 years after operation developed carcinomatosis of the peritoneal cavity. There was no local recurrence of the tumor, no metastases to lymph nodes or liver, but a diffuse implantation of cancer cells in the peritoneal cavity. Nothing had been done to prevent the implantation of the living cancer cells that were exfoliated into the lumen of the colon. Neither do surgeons hesitate to operate on cancers of the cervix when the vagina is known to be filled with exfoliated and viable cancer cells. Although they may knock cells off the tumor at every manipulation,

they often take no pains to destroy the primary tumor before removing the uterus. It is not surprising that massive implantations of cancer and recurrences in the vaginal cuff are common sequelae of operations for cancer of the cervix. Nor is it astonishing that the results of operation for cancer of the fundus of the uterus are better when the exfoliating tumor is destroyed by radium before the hysterectomy is done.

In 1914, Jones and Rous injected a suspension of cells from a transplantable cancer into the peritoneal cavities of mice. There was no growth of the cancer in the undamaged peritoneal cavity, but cancer grew in the injured tissues of the needle tract. Then tiny glass rods were put in the abdominal cavities of the mice and 2 weeks later cancer cells were injected. In almost every case a cancer developed exactly at the site of the glass rod. The natural resistance of the animals was able to dispose of the cancer in the normal peritoneal cavity,but could not do so in the presence of injury. The same high incidence of transplantability was observed when the peritoneal cavities of the mice were injured by the injection of an irritating powder. Carcinomatosis almost invariably ensued.

The Krukenberg tumor of the ovary which occasionally is seen secondary to a cancer of the stomach or colon does not occur, in my experience, in women beyond the age of ovulation. Often there is no gross cancer on the peritoneum except on the stomach and ovary. If injury causes localization of cancer, then ovulation, and its attendant damage to the peritoneal surface, could break the natural resistance of the peritoneum and cause cancer cells exfoliated from the serosal surface of the stomach to grow. When we know that 10 per cent of operable cancers of the colon have cells demonstrable by smears taken from their peritoneal surfaces it is frightening to think of the possible damage that even an exploratory operation might do. The same is true in cancer of the stomach. I have poured a little saline over the serosal surface of untraumatized cancers of the stomach and then recovered the saline and examined it for cancer cells. In 5 consecutive cases in which there were no signs of carcinomatous implants but the serosa showed the white infiltration of cancer, cancer cells were found in the washings. Even in the absence of gross carcinomatosis or ascites the abdominal cavity is apt to be filled with cancer cells. In such cases everywhere that the peritoneal surfaces are touched they may be damaged and cancer cells that might not otherwise survive may be implanted at the points of injury. Consideration of this possibility immediately raises the question of whether early treatment is advantageous for all cancers in the serous cavities. Perhaps in some kinds of cancer even an exploratory operation may do harm.

Studies of the alterations in tissue following trauma show that there are local chemical changes which may favor implantation of cancer cells at the site of injury. Dunphy and Udupa have shown that the so-called "lag period" of healing, which occupies several days between the time of trauma and the first microscopic evidence of repair, is not a lag period at all but a time devoted to rapid mobilization of those chemicals which promote the growth of tissue. The body concentrates the necessary chemicals at the site of injury just as a farmer concentrates fertilizer on the fields in which he wishes his seeds to grow. If cancer cells fall into an area fertilized by the results of injury, the cells are given every chance to grow.

The field of operation may not be the only site of tissue damage. No one knows what effect a general anesthetic, a reduction in blood pressure, or a period of anoxia may have on individual cells of liver, lung, bone marrow, or brain. If there is injury to these cells then the forces of repair are mobilized, implantation of circulating cancer cells may be promoted, and metastases may grow at the site of microscopic, subclinical injuries. When cancer cells are widely distributed in circulating blood and lymph, injury to tissue may determine the sites of the metastatic growth.

THE POSSIBLE VALUE IN SOME CANCERS OF AN INITIAL ATTACK WITHIN THE LYMPH NODE BARRIER

If we think of the various types of cancer that occur in a single organ as having different patterns of behavior, just as animals of different species have different patterns of behavior, then we will not expect a basal cell type of cancer to behave like a melanoma any more then we would expect, with the passage of time, to see a tortoise begin to behave like a hare. The problem is to recognize the biologic equivalent of the basal cell cancer when it occurs in the internal organs.

Perhaps, in some cancers, the factor of time could be used to differentiate the various types. Perhaps in some cases a simple mastectomy would be the best initial attack on a primary cancer of the breast. The passage of time, and careful observation of the axilla, could then help us to determine whether the patient is cured or whether radical axillary dissection, roentgen therapy, or treatment with hormones should be employed. This principle of graded treatment has long been used in the management of cancers of the skin, and it has never been proved that "prophylactic" resections of clinically normal lymph nodes are more curative than resections performed promptly when involvement of the nodes becomes apparent.

There is clinical evidence that the initial surgical attack on cancers like those of the breast, which have a marked propensity to systemic spread, should be confined to the area of the primary tumor. Williams, Murley, and Curwen of St. Bartholomew's Hospital in London report that the long range results from simple excision of breast cancer or simple mastectomy are comparable to or even better than those from radical mastectomy. In a survey of world literature Deaton found that the 5 year survival rate of 808 patients treated by simple mastectomy was more than 5 per cent higher than that following radical mastectomy. In a carefully followed series of 142 cases of carcinoma of the breast Meyer and Smith found that the 5 year survival rate after simple mastectomy was 8 per cent higher than that following radical mastectomy. Apparently, in some cases, the danger of a cancer spreading spontaneously from involved lymph nodes is less than the danger of disseminating it by removing the lymph node barrier.

Not all cancers that have metastasized to lymph nodes are fatal, even when the involved nodes are not removed. I have seen a woman who lived for 32 years with proved but untreated carcinoma of the thyroid in cervical lymph nodes. The cancer never spread farther and the patient died of other causes. If cancers of the thyroid can do this, if some cancers of the breast can lie dormant in nodes for 25 years or more, so may some cancers of the stomach and colon lie localized and harmless in the nodes for long periods of time. I have seen a patient develop a recurrence of cancer in lymph nodes 9 years after resection of a cancer of the stomach and I have heard of one in whom cancer lay dormant in nodes for 17 years. Perhaps, in these cases, if "second-look" operations had been performed, the cancers might have been disseminated to the peritoneal surfaces and caused earlier deaths. Serosal cavities are so vulnerable to the implantation of cancer that the most serious consideration should be given to the possibility of disseminating highly malignant intra-abdominal cancers by secondary operations.

Some types of localized cancer are well adapted to radical surgical attack. When cancers of the gastrointestinal tract are causing obstruction, infection, pain, or hemorrhage, prompt operation is mandatory and often lifesaving. Radical resections of pelvic organs for localized central recurrences of cancer of the cervix may eliminate all residual cancer and if the ureters are properly transplanted, the patient may enjoy a comfortable and useful life. But perhaps other cancers, such as infiltrating "leather-bottle" cancers of the stomach, when they are causing minimal symptoms and by their very type are not curable by resection, should be

viewed in the same light as inflammatory cancers of the breast and operations should be avoided. A therapeutic trial of roentgen therapy to rule out lymphosarcoma might be preferable to the risk of dissemination that is incurred by exploration and biopsy. A policy of watching the development of this type of cancer and doing nothing so long as the symptoms are not severe might result in increased comfort and length of life. Perhaps in older people, thorough electrocoagulation of selected low-lying cancers of the rectum may be preferable to combined abdominoperineal resections. Better results might be obtained if each cancer and each patient with cancer were dealt with as an individual problem.

These thoughts about cancer are not answers to the problems of its treatment, they merely raise questions that should be considered before we generalize too much about cancer and place too much reliance on the classical philosophies and techniques. It would be astonishing if there were no truth in the conventional concept of the value of early and radical excision of cancer. No one can deny that prompt and radical excision may be a major factor in effecting a cure. No thoughtful surgeon can question the value of early eradication of preinvasive cancers. It is realism, not fatalism, that should dominate surgical thought. The challenge to surgeons is to preserve the good of prompt and radical surgery, to use it when it is effective, and to find a way to avoid operations that are useless or do nothing but harm.

SUMMARY

1. There is evidence that the type of cancer and the resistance of the host are the most important factors in the spontaneous spread of cancer.

2. Operations that relieve obstruction or correct the complications of cancer are valuable, but it is difficult to prove that the systemic spread of invasive cancer is often prevented by operation.

3. Since operations may disseminate previously localized cancer through the blood stream, through the lymphatics, and by implantation, the pros and cons of operations for cancer must be weighed carefully before operations designed solely to prevent the spread of cancer are advised.

4. The greatest challenge in the surgical field of cancer is to recognize and operate promptly on those patients whose cancers are adapted to surgical cure and to avoid operating on those in whom intervention does nothing but harm.

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THE ETIOLOGY AND PREVENTION OF VOLKMANN'S ISCHEMIC CONTRACTURE

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IN THE LATTER HALF of the nineteenth century, Volkmann described ischemic contracture of the forearm, which is characterized by a limb that is painful, cold, and cyanotic, with loss of motor function caused by rapid necrosis of the muscles and resultant fibrosis and flexion deformity of the fingers. Since that time, numerous articles have been published on this condition. Many reports conclude with the statement that the prevention of Volkmann's contracture is the best treatment. These articles correctly stress the importance of avoiding tight casts and dressings, and the danger of acute flexion of the elbow after supracondylar fractures. However, these precautions often are not enough to prevent ischemic contracture.

A review was made of the records in 92 cases of Volkmann's ischemic contracture seen at the Mayo Clinic from 1935 through 1954. Based on this study, this article attempts to outline the best means of prevention and early treatment when a patient is seen with impending Volkmann's ischemic contracture. An attempt was made to ascertain the cause of the contracture in each instance, as well as to estimate how many of these contractures probably would be preventable by use of present methods of treatment.

Meyerding (24, 25) and Meyerding and Krusen reviewed the cases of Volkmann's contracture seen at the clinic prior to 1935 and found that 69 of 162 such lesions followed supracondylar fractures. The incidence of patients with Volkmann's contracture from all causes encountered at the clinic prior to 1935 was 0.18 per 1,000 patients, whereas from 1935 through 1954 the incidence was 0.08 per 1,000. In Meyerding's series, the incidence was 0.08 per 1,000 orthopedic patients for Volkmann's contracture after supracondylar fractures; in the present series, the rate is 0.04 per 1,000 for the same condition. These figures are encouraging and attest to the better treatment that presently exists for fractures of all types. However, the incidence of this seriously crippling condition can be lessened considerably more.

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ETIOLOGY AND PATHOGENESIS

Most students of the subject are now agreed that major arterial obstruction is necessary for the production of Volkmann's contracture. Griffiths (18, 19) considered that primary traumatic arterial spasm was probably a less common cause of the obstruction than was organic block to the flow in the vessel, but he stated that spasm is still important. As pointed out by Foisie, segmentary spasm may be produced by minor injury to the arterial wall which is not sufficient to occlude the artery by the damage per se but causes the artery to occlude itself. Fontaine and Dany were of the opinion that venous stasis, which is often severe, coexists with the interruption of the arterial circulation and contributes to the muscular damage. Although the brachial artery usually is injured in supracondylar fractures and severe injuries about the elbow, direct injury to either the radial or ulnar artery by bony fragments is unlikely in fractures of the forearm. Garber considered that effusion probably follows direct injuries to the bellies of muscles in fractures of the forearm; as it progresses, the muscles swell within their sheaths. The increasing pressure gradually obstructs the venous drainage, with beginning anoxemia

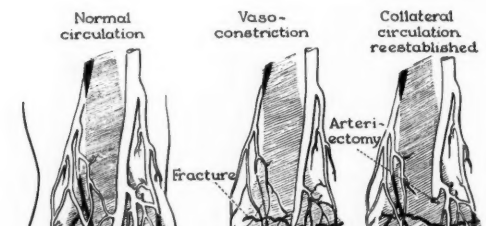

FIG. 1. Diagram of arterial circulation around the elbow. The left panel shows how the brachial, profunda, radial, and ulnar arteries, with their recurrent branches, form a rich collateral network. The center panel shows how injury to the brachial artery may produce spasm not only of the injured artery but also of the collateral vessels. The right panel shows how the spasm in the distal and collateral arteries is released when the damaged segment of the artery is excised.

of large sections of tissue. He stated that ischemic contracture after injuries of the elbow or forearm probably was the result of almost complete arrest of circulation in the flexor muscles of the forearm. Fontaine and Dany considered that tight plaster casts in themselves were not the main cause of Volkmann's contracture but that the compression produced by tight plaster only aggravated the previously existing circulatory disturbance. They showed experimentally that irritation of one segment of a humeral artery in the dog by means of an iodine compound caused vascular spasm followed by muscular contracture in the foreleg. They concluded that interruption of the blood supply and a cerebrospinal reflex mechanism rather than a sympathetic mechanism are equally important in the causation of Volkmann's contracture.

Brooks (4), in 1922, reported experimental studies in animals with isolated muscles having a single artery and a single vein capable of transmitting blood and concluded, after obstruction of the former vessel and then the latter, that the classic picture of Volkmann's ischemic paralysis could be explained only on the basis of acute venous obstruction. However, in later writings, Brooks and his associates (5-8) stressed that the magnitude of the changes is determined by the degree of venous obstruction of the entire extremity and pointed out that ligation of the vein accompanying an obstructed artery results in only a relative venous obstruction, since the collateral veins are not obstructed. It should be remembered that Brooks propounded his theories before the time when spasm of arteries and their collateral vessels was recognized and understood.

The earliest signs of Volkmann's ischemic contracture usually appear 4 to 6 hours after the injury or the institution of treatment. In a few cases, however, the onset has been noted after 48 hours; in others, the delay has been as long as a week. Fontaine and Dany concluded that the condition appears more often in the third or fourth week, particularly at the time of removal of the plaster cast. It appears likely, however, that the contracture had been present longer than this in their cases and was recognized only when the cast was removed.

Blount, Bowden and Gutmann, and Cregan, as well as others, have pointed out that constriction or division of a main vessel does not invariably lead to ischemic necrosis. Absence of radial pulsations alone does not indicate impending Volkmann's contracture. Leriche, Cohen (9-11), and others have suggested that the arterial spasm which accompanies injury to a major vessel must extend far enough to involve the vessels on which the collateral circulation depends if ischemic necrosis is to occur; I am in complete agreement on this point (Fig. 1). Massive necrosis occurs if spasm of the main vessel involves the collateral vessels or the branches supplying the muscles and if it persists for a sufficient length of time. As pointed out by Bowden and Gutmann, the vulnerability of certain muscles to vascular damage is partly related to the intramuscular vascular pattern. The vascular patterns of the flexor and the pronator muscles in the forearm probably ex-

plain why these structures are involved so much more often in Volkmann's contracture than are the remaining muscles in the forearm.

When muscles become ischemic they lose their elasticity by degeneration of the fascicles and eventually resemble muscles seen in rigor mortis. Strauss found that ischemic muscles are in a state of continuous involuntary tonic contracture. They are hard to the touch and do not appear to be completely paralyzed. It is impossible, however, to stretch the shortened muscles passively. Such contracture only adds to the ischemia. Brooks and Johnson, in 1932, stated, "Blalock has shown that during contraction of a muscle the flow of blood is not only completely stopped, but also that the blood already in the arterioles is actually forced back in the artery supplying the muscles." If ischemia is not corrected, the muscles become necrotic and eventually are replaced by tough, fibrous tissue. Fontaine and Dany stated that the picture changes slowly into that of sclerosis after 48 hours. Scar tissue envelops the nerves and soft tissue. They also pointed out that there are two stages in Volkmann's contracture, namely (1) an early stage that predominantly consists of tonic contracture and that can be helped in certain instances by early operative intervention and (2) an anatomically irreversible fibrosis.

Goldner stated that the anatomic structure of the median and ulnar nerves makes them particularly susceptible to injury from this tonic contracture and fibrosis, as well as from direct ischemia of the nerves themselves. The median nerve normally lies in a relaxed sling as it passes between the two heads of the pronator teres and the arch formed by the juncture of two heads of the flexor digitorum sublimis; likewise, the ulnar nerve lies in a relaxed sling as it passes between the two heads of the flexor carpi ulnaris. When these muscles are contracted, the sling tightens and the nerves are strangulated (Fig. 2). Although the nerves might survive the ischemia that results from the arterial damage and spasm, in many instances

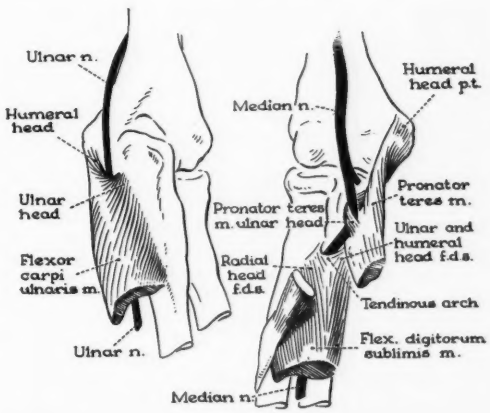

FIG. 2. Diagram of the ulnar and median nerves in the upper part of the forearm. Tonic spasm and fibrous contracture of the flexor carpi ulnaris may strangulate the ulnar nerve as it passes between the two heads of this muscle. The median nerve may be strangulated as it passes between the two heads of the pronator teres and under the tendinous arch of the flexor digitorum sublimis.

they cannot survive this added insult. Goldner demonstrated that the nerves often will regenerate if the strangulation is reduced even as long as several weeks after the onset of Volkmann's ischemic contracture.

It has been known for a long time that muscle fibers have the power of regeneration. Bowden and Gutmann, as well as Horn and Sevitt, have proved that muscles affected by ischemic necrosis are no exception. The prognosis in ischemia of human voluntary muscle depends on the extent and the reversibility of damage to both muscle and nerve fibers and on the extent of regeneration of muscle fibers.

PRESENT STUDY

Of the afore-mentioned series of 92 patients with Volkmann's ischemic contracture studied at the clinic from 1935 through 1954, 44 had this complication after supracondylar fractures of the humerus, whereas in 18 it followed fractures of both bones of the forearm (Table I). Other causes were fractures of the shaft of the humerus (7 cases), severance of a major artery or arteries as the result of lacerations or gunshot wounds (7

TABLE I.—DATA IN 92 CASES OF VOLKMANN'S ISCHEMIC CONTRACTURE SEEN AT THE MAYO CLINIC

Cause	*Patients*	*Sex*		*Average age at time of injury, years*	*Average interval between injury and admission, months*	*Grade of severity of contracture*			
		Male	*Female*			*1*	*2*	*3*	*4*
Supracondylar fracture of humerus	44	30	14	7	40	1	18	15	10
Fractures of both bones of forearm	18	17	1	21	59*	4	6	6	2
Fracture of shaft of humerus	7	3	4	25	27	1	0	4	2
Severance of major artery or arteries from laceration or gunshot wound	7	6	1	27	16	0	2	1	4
Dislocation of elbow	4	3	1	23	16	0	1	2	1
Miscellaneous	12	8	4	27	7	2	5	4	1
Total	92	67	25	16 (average)	35 (average)	8	32	32	20

*Ten years or more in 4 patients.

cases), dislocation of the elbow (4 cases), and miscellaneous conditions (12 cases).

Of special interest was the miscellaneous group. The contractures in 3 of these patients developed from fractures about the elbow itself; an additional 2 patients had fractures of the shaft of the radius alone, and 1 patient sustained multiple fractures of the humerus, both bones of the forearm, and the hand. Two patients had crushing and contusing injuries without fractures. Another patient, a 10 year old boy, sustained a wringer injury in which the skin was not broken but which caused a large hematoma in the antecubital fossa; this boy had been seen previously at the clinic and was considered to have pseudohemophilia, with an increased bleeding time. Another patient was a true hemophiliac who contused his arm 6 weeks before he came to the clinic; bleeding continued, and it was necessary to amputate the arm below the elbow. Another patient had undergone operation for congenital synostosis of the radius and ulna 4 months prior to examination at the clinic; the extremity had been immobilized in a cast in extension. The last patient in the miscellaneous group had been operated on for a traumatic arteriovenous fistula at the level of the elbow 4 months before coming to the clinic.

Sixty-seven of the 92 patients were male and 25 were female. The average age at the time of injury was 16 years. The average time that had elapsed from injury until the patient was seen at the clinic was 35 months, with a range of 4 hours to 27 years.

The right upper extremity was involved in 51 instances and the left in 41. The incidence of contractures that followed supracondylar fractures was the same in each extremity; this is difficult to explain since in my previous study made with Burleson the ratio of supracondylar fractures of the left upper extremity to those on the right side was approximately 2:1. As would be expected, the average age at the time of injury was least in those patients who had Volkmann's contracture after supracondylar fractures; the average age at the time of injury in this group was 7 years. In those patients who had contractures after fractures of both bones of the forearm, the average age at the time of injury was 21 years.

The contractures were classified as to the grade of severity. Grade 1 contracture was the mildest, with absence of nerve deficit. Grade 2 contracture was worse than grade 1 but moderate function of the involved muscles remained and nerve deficit was absent. Grade 3 contracture presented only slight function in the muscle fibers, severe contracture, and some, but not total, nerve deficit. Grade 4 contracture included severe nerve deficit and no active muscular function; the hand was practically useless in such cases. Eight of the contractures were classified as of grade 1 severity, 32 were grade 2, 32 were grade 3, and 20 were grade 4.

In the light of knowledge that was available in 1935, it was concluded that 38 of the 92 contractures were preventable; with present-day information, it was thought that 61

of the contractures probably would be preventable. Whether this residual fraction of instances of Volkmann's ischemic contracture will remain not preventable is problematic. Further study and effort should reduce this percentage even more.

TREATMENT

Of the 92 patients evaluated, 35 did not remain at the clinic for treatment or stayed for less than 2 weeks; the other 57 remained for 2 weeks or more (Table II). Fifteen of these 57 patients received splinting or physical therapy or both. Forty-two of the 57 patients underwent a total of 65 surgical procedures performed because of Volkmann's contracture (Table III). The operation performed most often and with most encouraging results in the late contractures was lengthening of the tendons of contractured muscles that were still capable of some function; this procedure was done on 21 occasions. Neurolysis was performed in 9 instances, and suture of the nerve was done at the time of neurolysis if the nerve had been severed. Transfer of tendons was performed on 8 patients, and carpectomy was done on 7. Arthrodesis of the wrist joints was done on 3 patients. Both bones of the forearm were shortened in 4 patients; this procedure usually was carried out when ununited fractures were present. Capsulectomy of 1 or more of the metacarpophalangeal joints was performed on 4 patients.

TABLE II.—TREATMENT IN 92 CASES OF VOLKMANN'S ISCHEMIC CONTRACTURE

	Treatment			
		Physical		
	None or	*therapy or*	*Surgical*	
	less than	*splinting*	*intervention*	
Cause	*2 weeks*	*or both*	*Patients*	*Procedures*
Supracondylar fracture of humerus	20	6	18	21
Fractures of both bones of forearm	6	3	9	17
Fracture of shaft of humerus	1	2	4	8
Severance of major artery or arteries from laceration or gunshot wound	3	1	3	3
Dislocation of elbow	2	0	2	6
Miscellaneous	3	3	6	10
Total	35	15	42	65

TABLE III.—SURGICAL TREATMENT IN VOLKMANN'S ISCHEMIC CONTRACTURE: 65 PROCEDURES IN 42 CASES

Surgical procedure	*Cases*
Lengthening of tendons	21
Neurolysis with or without nerve suture	9
Transfer of tendons	8
Carpectomy	7
Capsulectomy of metacarpophalangeal joints	4
Shortening of both bones of forearm and bone graft for ununited fracture	4
Arthrodesis of wrist	3
Excision of segment of damaged brachial artery*	1
Opening of fascial envelopes of flexor muscles in forearm and arterial sympathectomy†	1
Other	7
Total	65

*Arteriectomy was done 78 hours after supracondylar fracture and onset of early ischemic contracture; complete recovery ensued.
†Operation was done 13 days after supracondylar fracture and onset of contracture; questionable benefit ensued.

In 1 patient seen 2 weeks after a supracondylar fracture, the ulnar, radial, and brachial arteries were stripped of their sympathetic nerve fibers and the fascial envelopes of the flexor muscles in the forearm were opened. The arteries were in pronounced spasm, and the muscles were replaced by an almost jellylike necrotic material. Neurolysis of the median and ulnar nerves also was carried out. Although sensation returned to normal, the contracture that ultimately developed was moderately severe.

Another patient had sustained a supracondylar fracture 78 hours before examination at the clinic. The fracture had not been manipulated nor had a cast been applied, yet definite early Volkmann's contracture was present. There was complete glovelike loss of sensation of the radial half of the hand and wrist, with absence of the radial pulse and the presence of pain, pallor, paralysis, and beginning contraction of the fingers. Pronounced swelling was present. The patient was operated on immediately. When the antecubital space was opened, the brachial artery was found to be pinched in a longitudinal split in the proximal fragment of the humerus; the vessel below this point was in pronounced spasm. The injured segment of the vessel was excised and the stellate ganglion on the side of injury was infiltrated with procaine hydrochloride (novocain). The fracture was then treated by means of

skeletal traction, a Kirschner wire being placed through the olecranon process. The hand was warmer immediately after operation and the patient, on awakening from anesthesia, appeared to be much more comfortable. Complete recovery of function and sensation ensued during the next 2 months, and the fracture healed in satisfactory position.

COMMENT

It is evident that tight bandages, tight plaster-of-paris casts and acute flexion of the elbow are to be dispensed with after injuries to the upper extremity if Volkmann's ischemic contracture is to be avoided. However, as already mentioned, tight casts or bandages may not be the main cause of the contracture but may only aggravate a previously existing circulatory disturbance.

If fractures or dislocations about the elbow are reduced, the main artery or arteries are much less likely to be traumatized and the collateral circulation impaired. On the other hand, forceful manipulation during reduction of a fracture or dislocation of the elbow may cause injury to the brachial artery that may lead to thrombosis and arterial spasm. If the circulation is still precarious after reduction of the fracture or if it becomes precarious several hours or even days after the reduction and remains so after all external compression is released, immediate action is necessary. My associates and I have become convinced, as was stressed by Griffiths (18), that if, along with the first "p" of pulselessness, the other 3 "p's" of pain, pallor, and paralysis are noted, immediate exploration of the artery and nerves in the antecubital fossa is indicated. In only 2 of a group of 10 patients in whom the antecubital fossa was explored surgically by my colleagues and me was there any question as to irreparable damage to the brachial artery to such an extent that this structure was incapable of transmitting blood. Pronounced spasm of the artery distal to the point of fracture was present in all 10 of these patients except those who had complete rupture of the artery. After resection of a segment of the artery at the level of the fracture, the spasm was released and the rich collateral circulation about the elbow was allowed to take over. In none of these 10 patients did Volkmann's ischemic contracture occur and recovery of function was complete in all.

This idea is not new. Foisie, in 1942, collected reports in the literature of 30 cases of acute contracture. Arteriectomy, with removal of 3 to 5 centimeters of the contracted artery and simple ligation of both ends, was performed in 10 of these 30 cases; the best results were obtained in this group, with a return of adequate circulation and normal function in most instances. Arteriectomy has the advantage of complete interruption of the reflex mechanism in addition to removal of the segment of artery that possibly contains a small break or tear that is not visible grossly but is sufficient to maintain continued abnormal stimuli, which produce the spasm.

Aurousseau reported a case in which arteriectomy was done 28 hours after fracture and the onset of ischemia, with almost complete recovery 3 months later. Crystal and associates reported a case in which a thrombus was removed from the brachial artery 20 hours after injury. Fasciotomy, perivascular stripping, and stellate blocks had been of no avail in this case prior to arteriotomy and removal of the thrombus. This patient used his hand normally 2½ years later, although he had slight atrophy of the hand itself. This result would have been just as striking and perhaps even more so had arteriectomy been performed. Sarkar reported a case in which arteriectomy was done for a thrombosed segment of the brachial artery 3 hours after posterior dislocation of the elbow; complete recovery occurred. Cregan reported a case in which complete arterial arrest was present for more than 9 hours after injury; ischemic contracture did not occur. The ischemia was painless in this instance and even full passive extension of the fingers was well tolerated. The artery was found at operation to be in spasm but it was not resected and the patient made a satisfactory recovery.

As previously indicated, not all patients who have ischemia need surgical intervention; however, if pain, pallor, and paralysis are present along with pulselessness, then it is the duty of the surgeon to explore the antecubital fossa in cases of injury about the elbow and to resect the damaged segment of artery, if such is present. A segment of artery that is in spasm and does not appear damaged also should be resected when the spasm is not relieved by bathing the artery with an isotonic solution of sodium chloride and with a solution of procaine hydrochloride and by infiltration of the stellate ganglion with procaine. There is no known method in the presence of ischemia to determine whether or not adequate circulation will develop during the first 6 to 24 hours after reduction of the fracture. If one continues to observe the patient during this period, the golden opportunity for the prevention of crippling will have been lost.

In cases of rupture of the brachial artery, the antecubital fossa must be opened immediately and the ends of the artery ligated. In compound fractures or when a great deal of swelling is present, it is better to perform secondary closure of the wound a few days later than to attempt to close the wound under tension at the time of operation in the antecubital space. Intrinsic compression tends to decrease the collateral circulation; likewise, it has been proved that infection seriously impairs the collateral circulation.

If the antecubital space is opened and arteriectomy is performed, the fracture assumes secondary importance. It can be treated by gentle traction with a Kirschner wire or a Steinmann pin through the olecranon process, by closed reduction and fixation with crossed Kirschner wires or by reduction at a later period. All 3 of these methods have been used with success. At present, I prefer to reduce the fracture at the time of arteriectomy and to fix it with crossed Kirschner wires. This procedure was followed recently in a compound fracture with rupture of the brachial artery. The wound was closed 5 days after the injury; the patient made an uneventful recovery and never had symptoms or signs pointing to ischemia. After arteriectomy, a bulky Robert Jones type of dressing is applied. Block of the stellate ganglion usually is done immediately after operation but this may be unnecessary. If the circulation after arteriectomy still appears precarious, I would not hesitate to administer alcohol intravenously or to heat the other three extremities, but not the one that is injured, in an attempt to improve the collateral circulation.

The problem appears to be more difficult in cases of impending or early Volkmann's contracture after fractures of the radius and ulna and crushing and contusing injuries of the forearm. However the ulnar and radial arteries have been found to be in spasm in severe injuries in which surgical exploration has been done during the acute stage of edema and hemorrhage into the muscles. It is my present opinion that the following outline of treatment should be used in severe compound fractures with associated ischemia: (1) Cleansing and débridement of the wound, with extension of the incision into the fascial planes so as to release any intrinsic compression of the muscles or of the ulnar and radial arteries. The lower part of the brachial artery and the entire course of the radial and ulnar arteries in the forearm should be carefully inspected in all instances; if a point of irreparable local damage is observed, arteriectomy should be carried out at this point. (2) Delayed rather than primary closure of the wound. (3) Primary reduction of the fracture or fractures as indicated, provided this is possible and would not be too traumatic. Otherwise, the fractures should be reduced and fixed later, after all initial wounds are healed. (4) Application of a bulky Robert Jones type of dressing. (5) Block of the stellate ganglion. (6) Injection of a 5 per cent solution of alcohol by slow continuous intravenous drip. (7) Heating of the other three extremities and the remainder of the body but not of the injured extremity. (8) Avoidance of elevation of the injured extremity.

A similar procedure would be followed in contusing and crushing injuries of the forearm when the circulation appears to be in jeopardy. The use of hyaluronidase and a solution of procaine, as advocated by MacAusland and associates, to relieve the subfascial tension caused by edema and contusion could be considered immediately after injury; if the response is not quick, intrinsic pressure should be released by use of relaxing incisions that need not be closed until the early stages of edema and infection (usually 4 to 5 days) have passed. If necessary, grafts can be applied later for skin that becomes necrotic because of burns or contusions. By the adoption of such attitudes, it is my firm conviction that the incidence of Volkmann's ischemic contracture can be reduced further.

SUMMARY AND CONCLUSIONS

The records of 92 patients with Volkmann's ischemic contracture of the upper extremity seen at the Mayo Clinic from 1935 through 1954 have been evaluated. In 44 instances, the contractures followed supracondylar fractures, whereas they followed fractures of both bones of the forearm in 18 cases.

In light of the knowledge available in 1935, it is considered that 38 of the 92 contractures were preventable, but in light of present knowledge it is thought that 61 of the contractures probably were preventable. Review of these 92 cases and previous experience with another group of 10 patients seen from 1 hour to 72 hours after injury and on whom arteriectomy was performed because of irreparable arterial damage and impending Volkmann's contracture in some lead to the following conclusions:

1. Arterial injury with associated vascular spasm is the most important cause of Volkmann's ischemic contracture.

2. In the upper extremity, major arterial obstruction is not so important in the production of the contracture as is the associated spasm of the collateral blood vessels.

3. Early and adequate treatment of acute vascular spasm is necessary, even though it means surgical exploration of the antecubital fossa and forearm and resection of the injured or thrombotic segment of the brachial, radial, or ulnar artery.

4. In compound or other fractures and severe crushing and contusing injuries of the forearm accompanied by severe edema, attempts should not be made to close the wound primarily; instead, extension of the original wounds and use of relaxing incisions often are indicated.

5. Adequate and early treatment of acute vascular injuries of the upper extremities usually insures a good prognosis, but delay may lead to serious and permanent disability.

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EDITORIAL

DIAGNOSTIC ABDOMINAL TAP

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WITH THE INCREASE in the number of accidents in industry and on the highways there has been a marked rise in the number of severely injured patients admitted to the hospital. These patients present multiple problems in diagnosis and treatment. The use of abdominal paracentesis in the form of a diagnostic abdominal tap in making an early diagnosis of intra-abdominal injury in these patients is being more widely accepted by surgeons and is being used more frequently as experience with this procedure increases. The use of the diagnostic abdominal tap now has a definite place in the surgery of trauma.

A recent survey has been completed of 100 consecutive cases in which diagnostic abdominal tap was used in making a diagnosis of the presence or absence of intra-abdominal injury on the surgical services of the Los Angeles County General Hospital. These 100 consecutive cases were selected on the basis of the presence of multiple injuries, possible intra-abdominal injury, the use of a 4 quadrant diagnostic abdominal tap and the confirmation of the results of the diagnostic tap by surgery, postmortem examination, or subsequent clinical follow-up. During the 4 year period of this survey there were 528 patients admitted to the surgical services with a diagnosis of intra-abdominal injury. One hundred eleven of these injuries were due to penetrating objects, the majority of which were stab wounds and gunshot wounds, and these cases were discarded as diagnostic abdominal tap was not indicated. There remains a series of 417 cases in which there was blunt or crushing injury to the abdominal wall with possible intra-abdominal injury. In 23 per cent of these cases a diagnostic abdominal tap was used. The diagnostic abdominal tap was reserved for those cases in which there were multiple injuries or in which the symptoms of intra-abdominal injury were masked by shock, concussion, or hemorrhage. In making this survey it was noticed that the frequency of the use of the diagnostic abdominal tap has increased in the last year of the survey as the result of its wider acceptance by surgeons on the various services and that with experience there is no danger of penetrating the large or small intestine.

The diagnostic abdominal tap should be made in the 4 lateral quadrants of the abdomen, using four 18 gauge spinal puncture needles with local anesthesia, and introducing the needles into the abdomen in a manner one is accustomed to do in making an abdominal paracentesis. Before applying suction, the natural dynamics of the abdominal cavity are allowed to act in the hope that fluid or blood may be forced through one or more of the spinal needles. Suction is applied to the needles with a 10 or 20 cubic centimeter syringe. Blood, bile, intestinal contents, pancreatic fluid, and air have been obtained while using this method of diagnosis. The diagnostic tap should avoid any surgical scar that may be present on the abdominal wall. The only known con-

traindication to this procedure is marked abdominal distention. Two forces that may influence the collection or puddling of abdominal fluid and the accuracy of the diagnostic tap are gravity and peristalsis. The action of gravity is well known and allows fluid or blood from a lacerated liver or spleen to escape along either lateral abdominal gutter into one of the lower abdominal quadrants, or in the reverse direction in the presence of lower abdominal injury. The peristaltic action of the small intestine which is roughly in a downward direction may also displace fluid downward while the omentum aids in the action of gravity and peristalsis in the displacement of free fluid or blood in the abdomen. For these reasons the diagnostic abdominal tap must be made in the 4 lateral quadrants of the abdomen, and clinical experience has shown that a single abdominal tap over the area of suspected injury may lead to an erroneous negative diagnosis. The only contraindication to the tap that has been found after 4 years' experience is the presence of marked abdominal distention.

In 83 cases in which this procedure was used a positive tap was obtained in 61 cases, and the accuracy of the procedure was confirmed by surgery in 60 cases and by postmortem examination in 1 case. In the 22 cases in which the abdominal tap was negative for the presence of blood or fluid, the exclusion of intra-abdominal injury was accurate as proved by follow-up clinical study. In the majority of these 22 cases a final diagnosis was retroperitoneal hemorrhage from injury to one or both kidneys or from fractures of the pelvis or vertebrae. This type of injury produces retroperitoneal hemorrhage and abdominal findings very suggestive of intra-abdominal injury. The overall accuracy of the procedure in making a diagnosis in this series of cases was 83 per cent. In 17 cases, a negative abdominal tap was obtained but did not prevent the patient from going to surgery. The abdominal injuries in these negative taps were: spleen, 8; liver, 5; small intestine, 2; and duodenum, 2. Intra-abdominal hemorrhage from traumatic rupture of the spleen may be delayed from 2 to 21 days. The mechanism of this delay, subcapsular rupture of the spleen with delayed hemorrhage, tamponade of the injured spleen by omentum, and occasionally hemorrhage between the spleen and the diaphragm with a relatively free peritoneal cavity, is well known. In 1 case the surgeon described 1,000 cubic centimeters of free blood and clots in the abdominal cavity in which no blood was obtained by diagnostic abdominal tap. This error probably represents delayed hemorrhage or poor technique in making the diagnostic procedure. In traumatic perforation of the small intestine and duodenum the leak of intestinal contents is very frequently walled off by adjacent viscera and omentum and is not free in the abdominal cavity.

The automobile was the crushing instrument of injury in 66 of the patients in which the diagnostic abdominal tap was used in making a diagnosis. In a smaller group of patients the injuries were sustained by blows to the abdomen and in several a fall from a second or third story window. Many patients injured in serious automobile accidents sustain multiple injuries which present many problems in diagnosis as well as treatment. These patients on admission to the hospital were in shock and the treatment of shock helped to mask the usual clinical findings of intra-abdominal injury. Sixteen of the patients were admitted to the neurosurgical services because of head and facial injury and the presence of concussion. Intra-abdominal injury was suspected in these patients and by the use of a diagnostic tap an early diagnosis of an injured viscus was made. Repeated hemoglobin determinations and blood pressure readings were found to be of considerable value in watching the clinical course of the patient but were of no value in making a diagnosis of intra-abdominal injury.

In the analysis of these 100 patients the spleen and the liver were found to be the most vulnerable solid organs in the abdomen

and the pancreas less frequently. The hemoperitoneum which follows injury to the spleen and liver produces optimum intra-abdominal conditions for an accurate diagnostic tap. The second largest group was comprised of the patients whose injury produced a retroperitoneal hematoma of sufficient clinical size to give abdominal symptoms and signs of hemorrhage and the diagnostic tap was negative and proved to be conclusive for the absence of intra-abdominal injury. The third largest group consisted of patients with miscellaneous types of abdominal injuries in which the diagnostic tap gave results of surprising accuracy.

Traumatic injuries to the small intestine and duodenum do not give the best conditions for a diagnostic abdominal tap because of the tendency of the fluid to become walled off by loops of small intestine and the omentum. In this group of intra-abdominal injuries the diagnostic abdominal tap was less accurate. In a few unusual cases the diagnostic abdominal tap gave positive findings and laparotomy disclosed a lacerated cecum, traumatic rupture of the sigmoid, ruptured gallbladder, and traumatic pancreatitis. With increasing experience in the use of the diagnostic abdominal tap its accuracy has increased and there has been a wider acceptance of its use.

It would seem from the survey of traumatic cases admitted to a hospital which receives a large volume of injured patients that the following statements about the use of the diagnostic tap are warranted. The greatest value of the diagnostic abdominal tap is that an early diagnosis can be made of injured abdominal viscus in patients with multiple injuries. A negative tap is valuable in cases of retroperitoneal hemorrhage with the reservation that a negative tap does not always indicate absence of intra-abdominal injury and that if the patient's condition deteriorates a repeat diagnostic tap should be made. In all cases of suspected intra-abdominal injury in which symptoms are masked by shock, concussion, hemorrhage, or acute alcoholism a diagnostic abdominal tap is indicated.

THE SURGEON AT WORK

PERITONEAL-PERITONEAL SAC FOR EXCLUSION OF THE BOWEL IN THE SURGICAL APPROACH TO RETROPERITONEUM

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THE SURGEON OF TODAY operates surgically in regions of the body termed sacrosanct, impossible, or exceedingly dangerous by the master technicians of a few years ago. We know that these areas can now be invaded with relative impunity not due to greater technical skill on the part of the modern surgeon over his predecessor, but because of improved anesthesia, blood and fluid replacements, the antibiotic drugs, and better use of the research surgical laboratory. It is wise for the young surgeon of today to remember that technicians such as the great Deaver could tie a square knot with his fingers enclosed in a safety match box. The greater percentage of living and well patients following major surgery today is not due to more adroitness or training than the masters but is the result of the ancillary advances just mentioned. The question often posed today is not how much the surgeon can do to the patient, but how much he should do. The modern surgeon thus must become a surgical moralist who more and more must determine if the operation will make the patient physically happier as well as if it will permit him to live longer. As these operations become more usual, certain technical points necessarily are developed. Some of these may help the surgeon who enters these areas only occasionally.

The retroperitoneum is now the site of many operations. The removal of large tumors, extensive sympathetic surgery, resections of retroperitoneal bowel, and more particularly the resection of the abdominal aorta and its major branches now demands the attention of more surgeons. The transperitoneal approach to the retroperitoneum is attended by many difficulties. Not the least of these is the movement or mobilization of the bowel and its mesentery and its retraction to some area so it will not interfere with the operation, and also so it will not be injured during the many hours often necessary to complete operations in this area. Mobilization of the jejunum and the lateral mesentery of the large bowel has been advocated by some. The use of a Lahey bag in which to pack all of the intestines has been tried. The placing of all of the bowel upon the abdominal and chest walls protected by warm towels is used often but is a most unsatisfactory method. The bowel becomes so adherent as to be separated only with difficulty from such cotton coverings. Inflammation and at least a reactive peritonitis are inevitable. A simple expedient possible in most operations in this field has become routine practice in our clinic and is described.

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TECHNIQUE

After the anterior abdomen has been opened and explored, the bowel is temporarily retracted by packs, with the entire small bowel and its mesentery being placed in the upper abdomen and with the cecum and sigmoid retracted laterally. The bowel is retained by a Harrington type retractor. The retroperitoneum is then incised throughout its length over the area to be

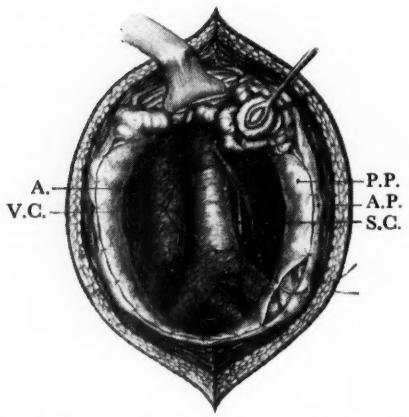

FIG. 1. Exposure of retroperitoneum. Retroperitoneum has been incised along the aorta, dissected free, and is being united to the anterior peritoneum by interrupted sutures. Bowel retained in its normal surroundings. Bowel at upper margin will be retained by pad. *A.*, aorta; *V.C.*, vena cava; *P.P.*, posterior peritoneum; *A.P.*, anterior peritoneum; *S.C.*, sympathetic chain.

exposed, the incision closely paralleling the medial border of the aorta. With a mounted or peanut type sponge on a forceps, the retroperitoneum is dissected from the underlying structures in an avascular plane. The anterior peritoneum is grasped with clamps and, if necessary, slightly loosened from the transversalis fascia and the muscles. The two layers of the peritoneum then are united with fine sutures placed on either side to the midline at the top. At the junction in the upper end of the angle of the wound, there will be a slight opening still remaining which can be closed with a very small laparotomy pad.

This procedure permits the retroperitoneum to be exposed without the protrusion of the bowel. Our experience has been that while the bowel loops can be packed away for a time, it becomes more difficult as the time of operation lengthens and the assistants tire and permit retractors to slip. The protrusion of several loops of bowel at a critical stage during the operation, such as in the anastomosis of a graft for the abdominal aorta, can cause a serious difficulty which can be obviated by the means described.

The anterior and posterior peritoneal covering is a tough resilient layer and unless it is torn, it will retain the bowel for an indefinite period. Thus the bowel is kept in its natural habitat, moist, not traumatized, and with no interference with its blood supply, its peristalsis, or its necessary integrity. Not only have previous experiences with wrapping in towels and lap pads technically been failures but, in trying to remove these pads after many hours, the adherence of the bowel to these pads has caused an intense inflammatory reaction and indeed at times bleeding.

CONCLUSION

It is suggested that other surgeons attempt this simple expedient. The only time it has not been successful in the author's practice has been when an inflammatory reaction, such as in an arteriosclerotic aneurysm, has caused the incorporation of the retroperitoneum into an aneurysmal sac.

The difficulty of retaining this bowel has been discussed at great length by many authors who have written on this subject. While the method described may have been used elsewhere, the author could find no description of it in recent surgical literature. It is described, not to be original, as others may have utilized the method, but in the hope that its description may be of as much help to other surgeons as it has been to those in our clinic.

THE SURGEON'S LIBRARY

The Book Shelf

EDWARD BROWN PIPER AND HIS FORCEPS FOR THE AFTERCOMING HEAD

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EFFORTS TO REDUCE the fetal mortality associated with breech delivery have been directed primarily toward improved methods for delivery of the aftercoming head. Evolution of the manual techniques began with the insertion of a finger in the infant's mouth, described by Guillemeau in 1621, with the subsequent addition of traction on the neck, as advocated by Mauriceau; suprapubic pressure on the fetal head, introduced by Wigand and Martin; and Smellie's method of allowing the infant's body to straddle the arm of the operator, designated by the Germans as *Reitenlassen des Rumpfes* (Klein). Forceps for the aftercoming head have had a long and checkered career, a satisfactory instrument being a late and relatively recent development in the history of obstetrics.

The first use of forceps for the aftercoming head is illustrated in Table 35 of Smellie's *Anatomical Tables* (7), published in 1754, a "lateral view of pelvis showing method of assisting delivery of head of fetus with long curved Forceps in praeternatural cases, when it cannot be done with the hands" (Fig. 1). The "long curved forceps," originally designed by Smellie for grasping a high head in cephalic presentations, was mentioned in the preface to his *Collection of Cases and Observations in Midwifery* (8) as also useful for delivery of the aftercoming head in breech presentations: " . . . among the improvements and alterations that have been made in the forceps, I mentioned a long pair, curved to one side, which I contrived several years ago, for taking a firmer hold of the head in the *Pelvis* when high; but I did not then recommend the use of them, because I was afraid of encouraging young practitioners to exert too great force, and give their assistance too soon. Of late, however, I have found them very serviceable in helping along the child's head, in preternatural cases, after the body and arms of the *Foetus* were brought down, and it could not be delivered without destroying the child, by overstraining the neck and jaw."

A Collection of Preternatural Cases and Observations in Midwifery (9), published in 1764, after Smellie's death, contains 3 interesting reports of cases in which the use of forceps was attempted on the aftercoming head. The first (Collection 34, Case 5), in 1750, is a case of failed forceps following efforts at application to the unengaged head. Smellie's account reveals his awareness of at least one shortcoming of the instrument as follows:

"The head, in this case, was to the right side of the *Uterus*: the breech on the left, near the *Fundus*, with the arms and legs backwards, as in the former case; but as the *Uterus* was not so strongly contracted, some of the waters still remained. I grasped the body with my left hand, and raising the head and shoulder to the *Fundus Uteri*, by which the breech was brought to the lower part, the legs with great ease were grasped and brought through the *Os externum*.

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FIG. 1. Plate from Smellie's *Anatomical Tables* (7), showing the first illustration of the use of forceps on the aftercoming head.

"In the mean time, the patient begged hard that I would do all in my power to save her child.

"The midwife informing me, that the woman had lost one formerly which came in the wrong way, and I finding that the child was alive by the motion of its legs, and that although it was not uncommonly large, the *Pelvis* was narrow; resolved to proceed with great caution, and do all I could to save the *Foetus*.

"The patient was in bed lying on her left side: but on this information I had her moved into the supine position. Having brought down the body and one arm of the child which lay before the face, I introduced two fingers of my left hand into the mouth . . . and the fingers of my other hand over the shoulders; then trying to deliver, I could not move the head down after several gentle efforts in this manner. I let go my hold of the under jaw, and tried *Daventer's* method by pressing down the shoulders to bring out the *Occiput* from below the *Os-Pubis*; but this failing also, and finding there was still a pulsation in the *Funis*, I resolved to try the Forceps.

"I now desired the midwife to hold up the body of the child so as to give me more room for introducing that instrument: but it being too short, and the head above the brim of the *Pelvis*, I could not fix them properly so as to render them of any use to assist delivery."

Smellie's second case (Collection 34, Case 7), was in 1753. He was called to attend a patient with a compound or shoulder presentation, with an arm prolapsed in the vagina. After performing version and extracting the legs and trunk and "finding there was still a strong pulsation of the arteries in the *Funis Umbilicalis*; and being afraid of losing the child by overstraining the neck; although I had failed with the short straight Forceps . . . yet I resolved to try a longer pair that were curved to one side, to suit the curvature of the *Os Sacrum* . . .

"Being properly seated, I introduced my right hand up the left side of the child's face. Then with my left hand I insinuated a blade of the *Forceps* up to that part. As I withdrew my right hand to make more room, I slipped the blade farther, that the end of it might reach as high as the upper part of the child's head: then I moved it towards the left groin of the patient, that the blade might be over the left ear, which was at that part: the part of the blade that was bent to one side, was to the *Pubis*; and the convex part was backwards to suit the concavity of the *Sacrum* . . .

"My left hand was next introduced up the right side, betwixt the *Sacrum* and *Ischium*, and along on the inside of my hand the other blade in the same cautious manner, over the right ear: having locked them together, I introduced a finger of my left hand into the child's mouth, to keep the face from turning upwards; then pulling the handles of the instrument with my right, and increasing the force, I brought down the forehead past the narrow part of the *Pelvis*; and turning it backwards to the concavity of the *Sacrum*, brought the head through the *Os externum*, by pulling upwards over the *Pubis*, to prevent a laceration of the *Perinôeum*.

"There was a small impression made by the Forceps on the scalp, which dispersed soon after: the child was strong and healthy; and although I used a good deal of force, the mother recovered without any uncommon complaints."

FIG. 2. Illustration from Baudelocque's *L'Art des Accouchemens* (1), showing Levret's forceps on the aftercoming head.

Two years later Smellie had another opportunity to use his long curved forceps on the aftercoming head, again with happy result: "In the year 1755," he wrote, "I was called to a case [Collection 34, Case 2] in which . . . after the body was delivered, the head of the child stuck at the brim of the *Pelvis* . . . I introduced a blade of the long *Forceps*, that were curved to one side, up along each side of the Pelvis, while an assistant held up the body of the child to give more room for their application; and having fixed them on the head, and joined the blades of the instrument together, I introduced two fingers of my left hand, and fixed them on each side of the child's nose, while my right pulled the head with the instrument, and delivered it safely.

"These two successful cases gave me great hope, that the above method would be of great service to save the lives of many children, who are generally lost by overstraining the neck in delivering the head; but a third in which I failed [Case 5], shewed, that we ought never to trust too much, or be over sanguine, with respect to any particular method of practice; but vary the same as we find it necessary . . .

" . . . the practice is advisable; especially when we are certain that the child is alive from the pulsation of the *Funis*, or motion of the body, or would prevent overstraining the neck, or avoid using the crochet . . . "

The use of forceps on the aftercoming head was soon taken up by others. In Baudelocque's book, *L'Art des Accouchemens*, published in 1781, 13 pages of text and 2 illustrations (Fig. 2) are devoted to this topic, and the technique is described for using Levret's forceps for the aftercoming head as well as in cephalic presentations.

The forceps later fell from grace for use in breech deliveries, and for a number of years remained in disfavor as an instrument for the aftercoming head, especially in Germany. The negative attitude that now prevailed among the profession toward forceps extraction of the aftercoming head was attributable in part to the lack of a truly satisfactory instrument for the purpose, but perhaps to a greater extent to the hostility of certain authorities, notably Karl Schroeder. In his textbook on obstetrics (1874) Schroeder had written, referring to the use of forceps on the aftercoming head: " . . . in the not too difficult cases it is unnecessary and worsens the prognosis, at least for the child; and in very difficult cases it is of no value to the child but is far more dangerous to the mother than perforation of the aftercoming head."

FIG. 3. Pages from original paper by Piper and Bachman (5), illustrating Piper forceps and its use. (By permission of the *Journal of the American Medical Association.*)

Early in the twentieth century interest was renewed in forceps assistance in breech deliveries, largely through Döderlein's more sympathetic attitude toward the instrument's potential value for this purpose; and in 1922 a favorable report by Nürnberger on the results of forceps extraction of the aftercoming head appeared from the Universitäts-Frauenklinik in Hamburg.

Piper's forceps for the aftercoming head (Fig. 3), described in 1929 after 5 years' use by the author, has now withstood the test of a quarter century of clinical evaluation by the profession and remains the most satisfactory instrument of its type yet developed. In contrast to the vast array of obstetric forceps for cephalic presentations, the Piper instrument remains the principal if not sole forceps in current use for the aftercoming head, at least in the United States. Its

characteristics, as described by its inventor, are: "(1) a blade having a somewhat flattened pelvic curve for high applications, as in the Tarnier forceps; (2) a lengthened shank, which permits an unusual degree of 'spring' between the blades and thus prevents compression of the head; and (3) depressed handles for greater ease of application and manipulation in the presence of the delivered fetal body."

The technique of application, in the words of Piper and Bachman, "requires aiming the blades directly at the intended positions on the sides of the head, without rotation, and from below. An assistant meanwhile holds the child's arms and legs . . . maintaining the trunk at not too great an angle of extension on the neck. Whether absolutely required for extraction of the head or applied as an elective maneuver, the chief function of the instrument is that of flexion and not traction; in addition, it serves to control the exit of the brow across the perineal edge, protecting the latter from the lacerations that sometimes occur as the head 'jumps' out in this final act of the birth."

The recommended role of the Piper forceps in breech delivery they described as follows: "Of the standard methods now available [for delivery of the aftercoming head] all are efficient in the average, uncomplicated case, but most of them, with the exception of those employing forceps, have disadvantages when one encounters high arrests or failures of engagement. The least objectionable of the manual methods is the Wigand, as is any method which aims to avoid imposition of too great a degree of traction on the neck. Even in this, however, there is danger of inflicting tentorial lacerations from too vigorous suprapubic pressure, or of impacting the head in the anteroposterior diameter of the superior strait, in one's anxiety to effect rapid delivery. With this in mind we follow the plan of making only one gentle effort to deliver the head with the Wigand method and, in the event of failure, pass at once to the use of forceps."

Edmund Brown Piper was born in Williamsport, Pennsylvania, April 20, 1881 (2). Although he was known to have organic heart disease from the age of 12, he managed to maintain his place among his contemporaries and was not seriously handicapped by it until his later years. He received his B.S. degree at Princeton in 1902 and then entered into the world of business, working for the Williamsport Water Company for 5 years before deciding to study medicine. He then entered the University of Pennsylvania Medical School, graduating in 1911. After internships at the Children's Seashore House in Atlantic City, the Mercy Hospital in Pittsburgh, and the University Hospital in Philadelphia, and a brief period in private practice, he enrolled with the University Unit of the Ambulance Service in France in 1915. In 1917, after the United States' entry into World War I, he returned with the American Expeditionary Forces to France, where he commanded several Camp Hospitals. At the conclusion of the war, Piper returned to private practice in Philadelphia, specializing in obstetrics and gynecology. Here he held a number of important hospital and teaching positions, including the professorship of obstetrics and gynecology at the University of Pennsylvania and chief of service at the Pennsylvania Hospital. In 1924 he served as President of the Philadelphia Obstetrical Society. He carried out some of the early experiments on the intravenous injection of mercurochrome, later adapted to human use in cases of bacteremia. Although Piper is best known for his forceps for the aftercoming head, he also devised other types of instruments, including an axis traction forceps. He died suddenly on January 14, 1935.

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Reviews of New Books

THE NEW ADDITION, Section III, to *A Stereoscopic Atlas of Human Anatomy*[1] by David L. Bassett adds to the previously prepared sections on *The Central Nervous System* and the *Head and Neck* 196 beautiful colored illustrations, chiefly of dissected specimens which portray in detail the anatomic structure of the upper extremity. In addition to the dissected specimens there are 22 illustrations of scapula, humerus, radius, ulna, and the bones of wrist and hand, and 6 roentgenograms, 2 of them angiograms of shoulder and hand. The 168 illustrations of dissections are divided about equally between the pectoral region and axilla, the shoulder, the arm, the volar surface of the forearm and of the hand, the dorsal surface of the forearm, and the dorsum of the hand.

One can imagine no better way of reviewing the anatomy of the upper extremity—both for the student who is fortunate enough to have access to these illustrations, or for the surgeon who is planning an operative procedure. Particularly for the orthopedic surgeon, the surgeon carrying out operations on the nerves and tendons and the surgeon planning any reconstructive procedure on the upper extremity these illustrations make it possible to review in his library the detailed anatomy of the part just as if he had before him dissected specimens such as the beautifully preserved dissections in the anatomic laboratory of the University of Texas Medical School in Galveston.

Bassett deserves very great credit for this most recent addition to the Atlas. The dissections are beautifully done and the photographic reproductions in color are works of art. One cannot commend them too highly. —*Sumner L. Koch.*

THE PREFACE to *Practical Obstetric Problems*[2] states that "the art of teaching is the art of sharing enthusiasm," and indeed the author's own zeal for obstetric teaching is evident throughout the entire book. The tiresome routines of antenatal care for the normal pregnant woman, which are well known even to the junior medical student, do not clutter up this text but are neatly confined to less than 12 pages.

Obstetric problems as they are encountered by the clinician are discussed in a brief and forthright manner. Chapters are devoted to pregnancy complicating heart disease, diabetes mellitus, anemia, pulmonary tuberculosis, and urinary abnormalities.

One is gratified to find special attention given to the *multipare grande* and to the elderly primigravida. A chapter is also devoted to the symptom complexes and the pitfalls of differential diagnosis in the pregnant woman. Common complications of pregnancy such as twins, hydramnios, breech deflection attitudes, antepartum and postpartum hemorrhage, as well as maternal injuries are all discussed concisely but adequately. Abortion, pre-eclampsia, and eclampsia are briefly and effectively treated. Up-to-date material is given regarding relief of the pain of childbearing, the use of antibiotics, the care of the premature infant, and the Rh factor.

This is a refreshingly practical book, well organized, and easy to read as to context, size, and print. A vast amount of practical material is contained in the 562 pages of the text which is appropriately illustrated with 43 pages of photographs and more than 25 drawings and diagrams.

This book will be very useful to the practicing physician as well as to the teacher of medical students and to the student himself.—*Augusta Webster.*

PART 1 of Stein, Stein, and Beller's *Living Bone in Health and Disease*[3] is a most complete compendium of our present knowledge of the structure and function of normal bone. Here in 87 well written pages, one is authoritatively brought up to date on the vast amount of study and research that has led to current concepts of the structure and development of cartilage and bone as well as the significance of the organic and inorganic elements concluding with the influence of the enzymes, hormones, and vitamins.

Part 2 devotes the next 380 pages to "Living Bone in Disease," in which emphasis is placed on the embryologic, the physiologic, the biochemical, and the pathologic derangements of bone. This part is profusely illustrated, and the 387 illustrations are excellently reproduced, correspond in page position with the text, and all roentgenograms are clear and in the preferred negative print. More careful editing and proofreading might have improved the syntax in this part and avoided much needless repetition and minor inaccuracies. However, practically every known bone disease is presented with the exception of giant cell tumor and bone cyst. Less than 1 page on malignant bone tumors in contrast to 73 pages on Paget's disease seems disproportionate. Indicated medicaments and other forms of treatment are more specifically and completely outlined in this book than in other similar treatises.

Fourteen tables in Part 3 are particularly valuable in that they reveal at a glance the chemical values in the innumerable bone disease entities encountered.

This book merits wide distribution and should appeal to all who are interested in, or deal with, bone in health and disease.—*Norman L. Higinbotham.*

IT IS FITTING that Lewison's book entitled *Breast Cancer and Its Diagnosis and Treatment*[4] should come

[1]A STEREOSCOPIC ATLAS OF HUMAN ANATOMY. Section III—UPPER EXTREMITIES. By David L. Bassett, M.D. Slides 85–112. $22.50. Portland, Ore.: Sawyer's Inc., 1956.

[2]PRACTICAL OBSTETRIC PROBLEMS. By Ian Donald, M.B.E., M.D., B.S. (Lond.), B.A. (Cape Town), M.R.C.S. (Eng.), L.R.C.P. (Lond.), M.R.C.O.G. 578 pages, 29 figures. $9.50. Chicago: Year Book Publishers, Inc., 1955.

[3]LIVING BONE IN HEALTH AND DISEASE. By Irvin Stein, A.B., M.D., F.A.C.S., F.I.C.S., Raymond O. Stein, A.B., M.D., F.I.C.S., and Martin L. Beller, A.B., M.D. 510 pages, 387 illustrations. $15.00. Philadelphia and Montreal: J. B. Lippincott Co., 1955.

[4]BREAST CANCER AND ITS DIAGNOSIS AND TREATMENT. By Edward F. Lewison, B.S., M.D., F.A.C.S. 478 pages, 181 illustrations. $15.00. Baltimore: The Williams & Wilkins Co., 1955.

from the center where William Halsted made so many time-honored contributions to the treatment of this disease. Lewison and his collaborators, all of whom are noted for their work in this field, attempt to synthesize all important information about cancer of the breast and present it in a practical form for the clinician's application to the individual patient. By combining a logical review of the vast body of accumulated knowledge concerning breast cancer with practical clinical experience, the volume gives the reader a comprehensive and highly informative, yet readily understandable discussion of every aspect of the care of this disease.

By way of introduction, the history of cancer of the breast from ancient times is presented briefly and succinctly. This first chapter concludes with a discussion of the contributions of Halsted and of the many very pertinent observations he made almost three-quarters of a century ago.

The book is illustrated with all types of photographic demonstrations, in color and in black and white, and with sharp, clearcut medical drawings, particularly of mode of spread and surgical techniques. Each chapter is followed by a summary which assists the reader in his appraisal of conclusions and in his critical evaluation of the many contributions on the subject.

Following the historical review, the surgical anatomy of the breast is presented comprehensively, and the application of anatomy, particularly of the lymphatics in relation to radical mastectomy and to complete excision of the tumor, is thoroughly considered. The following chapter, which discusses every aspect of the physiology of the breast, includes a concise review of the role of the endocrines on the breast, which is influenced by more hormones than any other organ in the body.

A chapter on mammary cancer in mice describes the information gained from such studies and, in the summary, presents a well documented and readily understandable discussion of the application or lack of application of these experimental data to human breast cancer.

The pathology of benign and malignant lesions of the breast is clearly depicted both in colored photographs of gross lesions as seen in the living state and in photomicrographs. The problem of a relationship between benign and malignant breast lesions is considered.

The discussion of psychologic aspects of breast cancer, including the shock-like preoperative and postoperative emotional reactions, stresses the need of the patient for reassurance, preferably by the operating surgeon who should assume full responsibility for total care, counsel, and consolation being among his prime responsibilities.

Concerning diagnosis, the author quotes a pertinent observation made by Halsted 50 years ago:

"It well repays the experienced surgeon to spend perhaps an hour in the examination of certain breasts. The diagnosis has usually and unfortunately been extremely simple. But women are now presenting themselves more promptly for examination, realizing that a cure of breast cancer is not only possible, but, if operated upon early, quite probable. Hence, the surgeon is seeing smaller and still smaller tumors—cancers which give not one of the cardinal signs."

The methods of diagnosis are enlarged upon, beginning with the features related in the history, examination, exfoliative cytology, biopsy, roentgenograms, and differential diagnosis. Detailed methods of examination are carefully described and illustrated. The end results of the various methods of treatment for breast malignancy are analyzed by easily interpreted charts, and the pitfalls of various computations are pointed out.

Surgical techniques for various types of procedures such as simple and radical mastectomy are reviewed, and the extended radical mastectomy is discussed by authors who originated and have had extensive experience with this operation. The discussion of surgical treatment includes a thorough analysis of many current impressions concerning prognosis, with careful scrutiny of reported results, and presents a rational evaluation of such factors as age, duration, cell type, tumor size, and location. Signs of operability and inoperability are considered in detail. The discussion of the indications for radiotherapy following radical and simple mastectomy includes an account of the most recent innovations.

The book reviews the basic endocrine physiology, its relation to mammary stimulation by hormonal alterations, and its significance in the palliative treatment of advanced cases. The discussion of controversial aspects of treatment, such as oophorectomy, adrenalectomy, hypophysectomy, and cortisone therapy, and of the detailed use of male and female sex steroids, will be of great value to the practitioner.

Chapters on breast cancer and pregnancy or lactation, self-examination of the breast, statistics of breast cancer, and cancer of the breast in the male, conclude this comprehensive presentation of available knowledge about this complex, common malady.

It is the impression of the reviewer that this is the most informative and the most useful single volume available for the medical student, the practitioner, and the research worker interested in this field.

—Leon Goldman.

A SURPRISINGLY COMPLETE, easy to read outline of the basic essentials of the diseases and development of infants and children is presented in *Survey of Clinical Pediatrics*[5] by Lawrence B. Slobody. It will give the physician with proper background a handy reference for basic facts and the student, pressed for time, a quick review of the field of pediatrics.

The outline form of this volume reflects the author's apparent experience of attempting to teach properly an ever widening subject in less and less time. Consequently, this second revised edition should quickly refresh and crystallize the necessary knowledge for the busy physician teacher who is faced with the problem of day to day indoctrination of students in pediatrics. The review questions at the end of each section will stimulate further detailed reading which can be found in the supplied list of reference books.

—L. Martin Hardy.

[5]SURVEY OF CLINICAL PEDIATRICS. By Lawrence B. Slobody, M.D. 2nd ed. 502 pages, $9.50. New York, Toronto, London: McGraw-Hill Book Co., Inc., The Blakiston Division, 1955.

THE CURRENT AWARENESS of electrolytes and fluids in the practice of medicine and surgery might well justify the publication of another book which would summarize investigations, clarify the conclusions which have been reached, and define the deficiencies in our present insight. The failure of the voluminous book, *The Body Fluids*,[6] to fulfill these expectations appears to stem from several fundamental traits, namely, turbidity, prolixity, and indiscriminate elaboration. Quoting from the section on "Internal Transfers of Fluid":

"It should be remembered that the solvent has a concentration as well as the solute, i.e., from the standpoint of energy gradients a low concentration of solute, in relation to solvent, is a high concentration of solvent, in relation to solute. Therefore, solutes and solvents move along gradients which are opposite in direction. The net result of these shifts in solute and solvent on the volumes of the respective phases will depend upon the relative rates or coefficients of diffusion of the solutes and solvents involved. The kinetic energy in the gradients is regarded as being derived from whatever process initially produced the change in concentration."

This paragraph and the following ones which deal similarly with osmosis, active transport, mass movement of fluid due to hydrostatic pressure gradient, and flux and turnover are implemented with diagrams which are either superfluous, or, because of the sketchy captions and tricky configurations, confusing.

The proliferation of illustrative material where illustration offers no advantage is conspicuous in chapter 4, "The Water and the Electrolytes of the Body in Health." Here we find graphs showing normal values of sodium, potassium, bicarbonate, chloride, inorganic phosphorus, total proteins, albumin, and globulin, many of which were collected by Danowski in connection with flame photometry. For the reader who has worked with a flame photometer, some of the values appearing on this series of graphs are more suggestive of the health of the photometer than of the subject. There is also a graph showing day to day fluctuations in the serum electrolytes of healthy children. The values are presented as dots along horizontal lines which spread to each side of a vertical line. The vertical stands at the zero point of a subjacent scale, indicating plus values to the right and minus ones to the left. The graph bears the following rather bewildering caption: "The points on each line represent variations from the initial value in the same individual as measured on different, not successive, days. However, the position of the point on the line does not indicate the sequence of the samples."

The scope of the book is broad and the bibliography is extensive. It is disappointing that its usefulness is limited by a lack of discrimination in the selection and assembling of the material and of clarity in its presentation.

—*Edith B. Farnsworth.*

[6] THE BODY FLUIDS; BASIC PHYSIOLOGY AND PRACTICAL THERAPEUTICS. By J. Russell Elkinton, M.D., and T. S. Danowski, M.D. 626 pages, illustrated. $10.00. Baltimore: The Williams & Wilkins Co., 1955.

THE SHORT MONOGRAPH on the principles of urology, entitled *Leitfaden der Urologie*,[7] by Professor Dr. C.-E. Alken, is intended primarily for the medical student and the general practitioner. Although the book is too elementary for the specialist, and the treatment of the subject is often so brief as to be sketchy, the presentation of essential methods of diagnosis and treatment is clear and concise. The illustrations are excellent.

—*Frederick A. Lloyd.*

IN THE PREFACE to the third edition of *Surgery of the Ambulatory Patient*[8] the author states the purpose of the book very simply, that it is to be a text for guidance of physicians called upon to treat surgical lesions in ambulatory patients. There is very complete coverage of a great variety of such lesions, all that could be treated in ambulatory patients. The casual reader might be encouraged to extend his office surgical activity beyond the point of safety, but the author and his contributors are most careful to emphasize the limitations of ambulatory treatment.

The content of the book is arranged in 3 principal sections—surgical principles and lesions, regional surgery, and musculoskeletal system (fractures and dislocations). The first section opens with a chapter devoted to a survey of the field of ambulatory surgery. The next chapter mentions the equipment needed for ambulatory surgery, with good pictures of the office setup, arrangements, and instruments. Succeeding chapters deal with anesthesia (particularly local anesthesia), preoperative and postoperative care, dressings, surgical infections, open wounds, foreign bodies, and superficial tumors. The second section, on regional surgery, is a logical, well proportioned sequence of chapters dealing with the surgical problems of each part of the body. The third section opens with a chapter on general considerations in injuries of the musculoskeletal system and then in the following chapters the fractures of three regions are discussed—the rib cage and shoulder girdle, the upper extremity, and the lower extremity.

The book is well written, in a simple, concise style. Many of the excellent presentations of regional surgery are characterized by a brief but complete, almost outline-form treatment. The short section on the injection therapy of inguinal hernia is a good example of this. In every chapter essentials are stressed, and yet details of treatment are given, particularly when they relate to the patient's being ambulatory. In this connection the many good illustrations are very helpful. The list of references at the end of each chapter has been well chosen. A gratifying percentage of the articles listed is from the recent surgical literature.

This book is an excellent presentation of the field of surgery in the ambulatory patient. It should be in the library of every physician who sees surgical patients in his office.

—*Franklin Lounsbury.*

[7] LEITFADEN DER UROLOGIE; FUER STUDIUM UND PRAXIS. By Prof. Dr. C.-E. Alken. With a foreword by Prof. Dr. H. Boeminghaus. 163 pages, 82 illustrations. DM 16.50 $3.95. Stuttgart: Georg Thieme Verlag, 1955.

[8] SURGERY OF THE AMBULATORY PATIENT. By L. Kraeer Ferguson, M.D., F.A.C.S. With a section on Fractures by Louis Kaplan, M.D., F.A.C.S. 3rd ed. 866 pages, 664 illustrations. $12.00. Philadelphia and Montreal: J. B. Lippincott Co., 1955.

COUVELAIRE'S *Surgery of the Urinary Bladder*[9] presents a complete review of the subject. Aspects of vesical anatomy and physiology, which are significant in surgical treatment, are reviewed. Of interest is the author's discussion of hormonal aspects of vesical dysfunction.

Principles of technique, instruments, and suture materials are discussed in some detail. Surgical pitfalls, the dangers of ureteral injury, and problems in hemostasis are presented.

The section on cystectomy is especially interesting and contains much valuable information as to pelvic blood supply and hemostasis. The approaches to the bladder are also discussed. The coccygeoperineal route for access to the floor and posterior aspect of the bladder is presented, and its value in the correction of deep vesicorectal fistulas.

Some of the procedures described are not generally used and accepted in the United States. Although many useful technical maneuvers are offered, the description of the operative procedures is frequently not presented in sufficient detail.

The illustrations as a whole are good, but often not adequate in number and quality to clarify some of the important technical steps. In spite of these deficiencies, this volume makes for interesting reading and offers much useful information derived from the author's wide experience. —*Frederick A. Lloyd.*

IN THE MONOGRAPH entitled *Il carcinoma intraduttale epidermotropo della mammella*[10] originating from the Cancer Institute, Milan, Italy, the authors have succeeded in compiling and correlating a voluminous number of facts concerning Paget's disease of the breast. In this comprehensive study of the disease, the reader is taken through the embryology of the breast, through the historical development and background of the disease up to the present day, and the numerous theories of causation. The authors' personal experience with Paget's carcinomas was culled out of a total of 3,800 malignant tumors of the breast, seen during a period of 26 years. They found that the highest frequency of the disease was observed in the seventh decade of life as compared with the usual mammary cancer which reached its highest incidence in the fifth decade of life. The authors believe that the disease arises from the ductal portion of the mammary gland and oftentimes from the intraepithelial portion of the adnexa of the nipple.

In their opinion the migration of the tumor cells takes place by way of the intraductal route to the epidermis through the intraepithelial route. The most frequently described picture of the disease is a comedocarcinoma. They feel that this malignancy represents a transformation of the ductal cells which normally are devoted to the formation of foam cells. They emphasize the fact that cytologic examination of smears from the nipple is very important for diagnostic purposes. They were able to make the diagnosis by cytologic examination in 10 of their cases. They suggest that the name of Paget's disease be changed to epidermotropic carcinoma of the breast.

—*Frank W. Pirruccello.*

A SERIES OF MONOGRAPHS by the speakers at the 1954 meeting comprise volume II of *Clinical Neurosurgery*[11] of the Proceedings of the Congress of Neurological Surgeons. Kenneth G. McKenzie of Toronto, Canada, the guest speaker, contributed 5 monographs citing his neurosurgical experiences at the Toronto General Hospital. The first chapter is that of, "Intracranial Astrocytomas," the second, "Acoustic Neuroma," the third, "Surgical Treatment of Spasmodic Torticollis," the fourth, "Menière's Syndrome," and the final chapter is that of, "Trigeminal Tractotomy." While a detailed discussion of these monographs is impossible in this brief review, they can be classified in a group as a learned discussion by an independent thinker and neurosurgical philosopher who has meticulously analyzed and evaluated his experiences in neurosurgery.

Included in the volume is a symposium on cervical trauma by Edward Winant, Frank Mayfield, and Howard Rusk, and the medicolegal aspects by W. Scott Allen. The final chapter is that of a "Symposium on Medico-Legal Aspects of Head Injury" in which the electroencephalographic findings are discussed by W. F. Caveness; the legal aspects of epilepsy by Dean R. L. Barrow of the University of Cincinnati Law School; rehabilitation and compensation by W. Scott Allen; and neurosurgical considerations by A. E. Walker. This series of monographs constitutes a very worthy addition to neurosurgical literature.

—*David Cleveland.*

THE FOURTH VOLUME of the *Treatise of Surgical Technique* is entirely devoted to thoracic surgery. Nine prominent thoracic surgeons of the Paris University hospitals, with Marc Iselin as the editor, have contributed to the various chapters, each in his own field of interest.

In this textbook all of the emphasis is placed upon surgical technique with an indispensable minimum of space left for the discussion of symptomatology, indications, and preoperative and postoperative care. For every particular operative procedure, descriptions of the different procedures commonly employed are given as well as the one preferred by the author. As a result this fourth volume of the *Traité de technique chirurgicale*[12] is an ideal reference for one who after having assimilated the clinical aspects of cardiopulmonary pathology is learning the mechanics of thoracic surgery.

Following a well documented chapter on anesthesia in thoracic surgery and one on the various methods of thoracotomy the 1330 page book is divided into 3 parts: surgery of the lungs, heart, and chest wall. Space does not permit a detailed outline of the vari-

[9] CHIRURGIE DE LA VESSIE. By Roger Couvelaire. 260 pages, 104 illustrations. 2.450 fr. Paris: Masson & Co., 1955.

[10] IL CARCINOMA INTRADUTTALE EPIDERMOTROPO DELLA MAMMELLA (COSIDDETTO MORBO DI PAGET). By Umberto Veronesi, Gian Carlo Rabotti, and Carlo Sirtori. 141 pages, 80 illustrations. Milano: Casa Editrice Ambrosiana, 1955.

[11] CLINICAL NEUROSURGERY. Proceedings of the Congress of Neurological Surgeons, New York, 1954. Vol. II. 173 pages, 54 illustrations. $6.75. Baltimore: The Williams & Wilkins Co., 1955.

[12] TRAITÉ DE TECHNIQUE CHIRURGICALE. By B. Fey, P. Mocquot, S. Oberlin, J. Quénu, P. Truffert, M. David, M. Iselin, R. Dossot, R. Dubau, Ch. Dubost, J.-J. Galey, Y. Longuet, J. Loygue, J. Mathey, F. Palmer, J. Perrotin, J. Rudler, G. Thormeret, and J. Varangot. 2nd rev. ed. Vol. IV. 1,330 pages, 864 illustrations. 8,800 fr. Paris: Masson & Co., 1955.

ous chapters but suffice it to say that the authors have not sinned by omission. For instance, the 327 pages devoted to lung resections are replete with a "cookbook" luxury of detail which can be so valuable for the neophyte. On the other hand detailed descriptions of the many classical surgical procedures directed against pulmonary tuberculosis could have been more brief since in many cases their indications have become rare indeed. The 864 figures are simple, schematic, and illustrate step by step the technique of the particular procedure under discussion. This is most refreshing since in many surgical textbooks the reader gathers the impression that the illustrations serve mainly as a vehicle for the virtuosity of the artist rather than as a supplement to the text.

Unfortunately the various chapters on surgery of the heart are already outdated in many respects. This of course is inevitable. However, the reader will find excellent descriptions of the more classical procedures of cardiac surgery.

In summary the fourth volume of the *Treatise of Surgical Technique* is an excellent manual of surgical technique for the thoracic surgeon.

—*René B. Menguy.*

IN THE MONOGRAPH of 111 pages, *Formen des posttraumatischen Kopfschmerzes*,[13] the author has reviewed the clinical appearance of both typical and atypical trigeminal neuralgia, glossopharyngeal neuralgia, and the rarer facial (n. intermedius) neuralgia, together with the standard surgical forms of treatment by alcohol injection, coagulation of the ganglion, section of the root or nerve, medullary tractotomy, frontal leucotomy, and general medical measures. He points out that there should be no confusion between the diagnoses of these neuralgias and those which occur about the head following trauma. He decries the use of the word "neuralgia" as a loose term, meaning many things to different persons. He also believes that since pain is a matter of individual interpretation, especially as to degree, and always "a matter of the psyche," posttraumatic head pain with its wide diversity of clinical manifestations is particularly difficult to evaluate.

The pain about the head which follows trauma is seldom of the paroxysmal type seen, for example, in idiopathic tic douloureux. It may be mediated through any of the cranial sensory pathways: trigeminal, facial, glossopharyngeal, vagus, or posterior roots of second and third cervical nerves. It occurs in approximately half of all patients after head injury, more often than not is unaccompanied by any outward neurologic changes, is rarer among the younger age groups, and tends to ameliorate spontaneously after a few months, under symptomatic, conservative treatment. The most common distribution is through the ophthalmic branch of the trigeminal and the second and third cervical nerves, covering both sides of the head, particularly at the vault of the cranium. It is often accompanied by peculiar paresthesias. It is of rare occurence in the second and third trigeminal divisions, in the glossopharyngeal areas, or in the limited area of facial nerve sensory supply.

Through both animal investigation and operations on human subjects the author found such conditions after head trauma as arachnoidal thickening and scars constricting nerves, old blood coagulum at the base of the brain around the cranial nerves (particularly in the posterior fossa and at the uppermost cervical levels), and degenerative changes in the surface blood vessels. When conservative therapy is of no help, or when the pain is persistent and really severe after several months, operative treatment such as rhizotomy or intracranial section of the nerve will give the patient lasting relief.

The book contains many illustrative case histories, 28 illustrations, and many references to the current literature.

—*John Martin.*

THE NINETEENTH EDITION of the well known textbook, *Rauber-Kopsch Lehrbuch und Atlas der Anatomie des Menschen*,[14] combines, as its title indicates, both an extensive descriptive treatise and an atlas. That it should have passed through so many editions is in itself a tribute to its completeness and its popularity. The fact that a high percentage of the illustrations are the work of two men—Kopsch, the anatomist and Frohse, the artist—give a uniformity and consistency to the illustrations that add greatly to the attractiveness of these volumes.

A considerable number of illustrations, particularly those of bones, joints, and muscles in Volume I, are reproductions of beautifully clear photographs of prepared specimens, specimens prepared and photographed by Kopsch and with shading, and at times color, added by Frohse. Where lettering is placed on the illustration itself it is invariably done so deftly and neatly that it does not detract from the clarity of the picture—whether of bone, joint, or muscle—that is depicted.

In commenting upon these volumes one should not fail to mention the clarity of the anatomic descriptions. Even the student with a somewhat limited acquaintance with the German language should have little difficulty in following the text, but from the point of view of the surgeon it is the number and quality of the illustrations in these volumes that are particularly appealing. It is the mental picture of the bile passages, or the thyroid vessels, or the facial nerve that the surgeon must carry with him to the operating room, and nothing is so helpful in fixing such pictures clearly in one's mind as illustrations such as are presented in the very admirable and comprehensive new edition of *Rauber-Kopsch's Lehrbuch und Atlas der Anatomie des Menschen.*

From a technical standpoint also this new edition deserves high praise. It is a credit to the art of the printer and engraver. As has been true so often in earlier years and again in recent years the publishers of German scientific treatises are setting a high standard for their colleagues and competitors to emulate.

—*Sumner L. Koch.*

[13]FORMEN DES POSTTRAUMATISCHEN KOPFSCHMERZES (DER NEURALGISCHE SCHMERZ). By Dr. Elmar E. Bues. With a foreword by Prof. Dr. R. Wanke. 111 pages, 23 illustrations. DM 9.60. $2.35. Stuttgart: Georg Thieme Verlag, 1956.

[14]RAUBER-KOPSCH LEHRBUCH UND ATLAS DER ANATOMIE DES MENSCHEN. Edited by Dr. Fr. Kopsch. ALLEGEMEINES SKELETSYSTEM-MUSKELSYSTEM. GEFAESSYSTEM. Vol. I, 19th ed. 736 pages, 731 illustrations. DM 64.50. $15.35. Stuttgart: Georg Thieme Verlag, 1955.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

ATLAS OF TUMOR PATHOLOGY. Published by the Armed Forces Institute of Pathology Under the Auspices of the Subcommittee on Oncology of the Committee on Pathology of the National Research Council. Section III, Fascicle 7: Tumors of the Cardiovascular System. By Benjamin H. Landing, M.D., and Sidney Farber, M.D. 138 pages, 138 illustrations. $1.50. Section V, Fascicle 19: Tumors of the Thymus Gland. By Benjamin Castleman, M.D. 83 pages, 81 illustrations and 4 color plates. $1.00. Washington, D. C.: Armed Forces Institute of Pathology, 1956 and 1955, respectively.

TUBERCULOSIS IN OBSTETRICS AND GYNECOLOGY. By George Schaefer, M.D., F.A.C.S., F.I.C.S. 307 pages, 54 illustrations. $8.75. Boston and Toronto: Little, Brown & Co., 1956.

ANESTHESIA FOR OBSTETRICS; LABOR—DELIVERY—INFANT CARE. By Robert A. Hingson and Louis M. Hellman. 344 pages, 122 illustrations. $12.50. Philadelphia and Montreal: J. B. Lippincott Co., 1956.

SURGERY OF THE EYE—DISEASES. By Alston Callahan, B.A., M.S. (Ophth.), M.D., F.A.C.S. 447 pages, 263 illustrations. $25.00. Springfield, Ill.: Charles C Thomas, 1956.

PROGRESS IN CLINICAL OBSTETRICS AND GYNAECOLOGY. By T. L. T. Lewis, M.B., B. Chir.(Camb.), F.R.C.S. (Eng.), M.R.C.O.G. 594 pages, 90 illustrations. $12.00. Boston: Little, Brown & Co., 1956.

HISTAMINE. Ciba Foundation Symposium Jointly with The Physiological Society and The British Pharmacological Society in Honour of Sir Henry Dale. Edited by G. E. W. Wolstenholme and Cecilia M. O'Connor. 472 pages, illustrated. $9.00. Boston: Little, Brown & Co., 1956.

THE DOCTORS. By Andre Soubiran. Translated from the French by Oliver Coburn. 380 pages. $0.50. New York: Popular Library, 1956.

PSYCHOSOMATIC ASPECTS OF SURGERY. Edited by Alfred J. Cantor, M.D., and Arthur N. Foxe, M.D. The Proceedings of the First Annual Meeting of the Academy of Psychosomatic Medicine, Held in New York City, October 1954. 220 pages. $6.50. New York and London: Grune & Stratton, 1956.

CYTOLOGY OF THE BLOOD AND BLOOD-FORMING ORGANS. By Marcel Bessis. Translated by Eric Ponder. 629 pages, 405 illustrations and 22 color plates. $22.00. New York and London: Grune & Stratton, 1956.

HUMAN OVULATION AND FERTILITY. By Edmond J. Farris, Ph.D. 159 pages, 35 illustrations. $6.50. Philadelphia and Montreal: J. B. Lippincott Co., 1956.

PROGRESS IN HEMATOLOGY. Edited by Leandro M. Tocantins, M.D. With 27 contributors. Vol. I. 336 pages, illustrated. $9.75. New York and London: Grune & Stratton, 1956.

BORDERLANDS OF THE NORMAL AND EARLY PATHOLOGIC IN SKELETAL ROENTGENOLOGY. By Prof. Alban Köhler. Completely revised with reference to illustrations and to text by Doz. Dr. E. A. Zimmer. 10th ed. Translation arranged and edited by James T. Case, M.D., D.M.R.E. (Cambridge). 723 pages, 1300 illustrations. $24.50. New York and London: Grune & Stratton, 1956.

AN ATLAS ILLUSTRATING THE TOPOGRAPHICAL ANATOMY OF THE HEAD, NECK, AND TRUNK. By the late Johnson Symington, M.D., F.R.C.S., F.R.S. (A portfolio containing 34 plates.) $21.00. Reprinted and published for the Anatomical Society of Great Britain and Ireland. Edinburgh and London: Oliver and Boyd, 1956. (Distributed in the United States by Charles C Thomas, Publisher, Springfield, Illinois.)

TRAITÉ DE TECHNIQUE CHIRURGICALE. By B. Fey, P. Mocquot, S. Oberlin, J. Quénu, P. Truffert, M. David, M. Iselin, R. Dossot, R. Dubau, Ch. Dubost, J.-J. Galey, Y. Longuet, J. Loygue, J. Mathey, R. Palmer, J. Perrotin, J.-C. Rudler, G. Thomeret, and J. Varangot. 2nd rev. ed., Vol. V. 780 pages, 781 illustrations. 5.500 fr. Paris: Masson & Co., 1956.

ADVANCES IN INTERNAL MEDICINE. Edited by William Dock, M.D., and I. Snapper, M.D. Vol. VIII. 366 pages, illustrated. $9.00. Chicago: The Year Book Publishers, Inc., 1956.

THE NEUROSURGICAL ALLEVIATION OF PARKINSONISM. By Irving S. Cooper, M.D., Ph.D., F.A.C.S. 104 pages, 68 illustrations. $8.50. Springfield, Ill.: Charles C Thomas, 1956.

THE LUNG AS A MIRROR OF SYSTEMIC DISEASE. By Eli H. Rubin, M.D. 288 pages, 92 illustrations. $12.50. Springfield, Ill.: Charles C Thomas, 1956.

ATLAS OF EXFOLIATIVE CYTOLOGY—SUPPLEMENT I. By George N. Papanicolaou, M.D., Ph.D. 43 pages, 16 plates. $4.00. Cambridge, Mass.: Published for the Commonwealth Fund by Harvard University Press, 1956.

ACTAS Y TRABAJOS DEL VI CONGRESO LATINOAMERICANO DE NEUROCIRUGÍA. Bajo los auspicios del gobierno del Uruguay con la colaboración del centro de cooperación científica para América latina de la U.N.E.S.C.O. 1387 pages, illustrated. Montevideo, Marzo 21–24, 1955.

THE RECOVERY ROOM; IMMEDIATE POSTOPERATIVE MANAGEMENT. By Max S. Sadove, M.D., and James H. Cross, M.D. With contributions by 24 authorities. 597 pages, illustrated. $12.00. Philadelphia and London: W. B. Saunders Co., 1956.

NEW AND NONOFFICIAL REMEDIES, 1956. Containing Descriptions of Drugs Evaluated by the Council on Pharmacy and Chemistry of the American Medical Association. An Annual Publication Issued Under the Direction and Supervision of the Council. 540 pages. Philadelphia and Montreal: J. B. Lippincott Co., 1956.

A MANUAL OF PRACTICAL OBSTETRICS. By the late O'Donel Browne, M.B., M.A.O., M.A., LITT.D., F.R.C.P.I., F.R.C.O.G. Edited and largely rewritten by J. G. Gallagher, M.D., M.A.O., F.R.C.P.I., M.R.C.O.G. 3rd ed. 265 pages, 203 illustrations. $7.50. Baltimore: The Williams & Wilkins Co.; Bristol: John Wright & Sons Ltd., 1956.

AMERICAN COLLEGE OF SURGEONS

WARREN H. COLE, Chicago, *President*
DANIEL C. ELKIN, Lancaster, Kentucky, *President-Elect*

PRELIMINARY PLANS FOR THE 42nd CLINICAL CONGRESS THE CIVIC AUDITORIUM, SAN FRANCISCO, CALIFORNIA OCTOBER 8 to 12, 1956

SAN FRANCISCO has only one drawback, said Rudyard Kipling, "tis hard to leave." The American College of Surgeons is returning to San Francisco for the third time, to hold its 42nd annual Clinical Congress in what has been called "the loveliest city in the world." The first Clinical Congress in this city was in 1935, and the second in 1951. Surgeons, physicians, and students from all parts of the nation and many foreign lands are expected to attend this widely instructive and popular meeting.

Not previously noted in this Journal is another Congress innovation: for the first time, student representatives from 16 medical schools will attend the Clinical Congress, at College expense. The College believes that education obtained through attendance at scientific programs such as the Congress is as valuable to students as to practicing physicians. In support of this belief, and in co-operation with deans of approved medical schools of this country and Canada, it is planned that a number of senior medical students will attend Congress meetings every year. Schools will participate in rotation, depending upon the geographic location of the meeting. Students will be selected by vote of their classmates. At the Congress, Fellow-sponsors will meet with and advise the students daily, to insure that each student obtains the maximum benefit from this educational experience.

Headquarters for the meetings and exhibits will be the Civic Auditorium, with some sessions at the Mark Hopkins, Fairmont, and St. Francis hotels, all of which are within walking distance of each other.

Advance Registration

Clinical Congress forms for advance registration, hotel accommodations, postgraduate courses, and transportation may be obtained from The American College of Surgeons, 40 East Erie Street, Chicago 11, Illinois.

No registration fee is charged Fellows if dues are paid to December 31, 1955. If dues are not paid, the fee is $20.00. No registration fee is charged Initiates or members of the Candidate group. No fee is charged Surgical Residents, provided a note of identification signed by their chief of surgery or hospital administrator accompanies the advance registration form. Non-Fellows pay a $20.00 fee. Members of the Federal Services pay $10.00. The postgraduate course fee is $5.00, payable by everyone taking the course. The official Registration Desks will observe the following hours: Sunday, October 7, from 3 p.m. to 7 p.m.; Monday, October 8, 8 a.m. to 5:30 p.m.; Tuesday through Friday, 8 a.m. to 5 p.m. It is suggested that non-Fellows bring medical identification with them to simplify their registration.

Advisory Committee on Local Arrangements

Under the chairmanship of Dr. Frank Gerbode, the San Francisco committee has devoted

much time and thought toward insuring the success of this meeting. Members of this committee follow:

Frank Gerbode, *Chairman*
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Orville F. Grimes, *Secretary*
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Albert C. Daniels
Martin W. Debenham
John M. Erskine
Rutherford S. Gilfillan
Bert L. Halter
Floyd H. Jergeson
Donald R. Smith
Edwin J. Wylie

The Committee to Welcome Distinguished Visitors is composed of:

John W. Cline, *Chairman*
Frederick C. Cordes
Henry H. Searls
Ralph Soto-Hall
John R. Upton

PRELIMINARY PROGRAM

Evening Sessions

PRESIDENT'S EVENING

Monday, 8:30—10:00 p.m., Arena, Civic Auditorium

Warren H. Cole, M.D., F.A.C.S., Chicago; President, American College of Surgeons, *Presiding.*
Address of Welcome. Frank Gerbode, M.D., F.A.C.S., San Francisco; Chairman, Chicago Advisory Committee on Arrangements.
Introduction of Guests. I. S. Ravdin, M.D., F.A.C.S., Philadelphia; Chairman, Board of Regents.
The Eleventh Martin Memorial Lecture. Vannevar Bush, Cambridge.

CONVOCATION

Friday, 8:30—10:00 p.m., Arena, Civic Auditorium

Warren H. Cole, M.D., F.A.C.S., President, *Presiding.*
Procession. Initiates, Governors, Officers, Regents, and Guests.
Invocation.
Presentation of Initiates and Conferring of Fellowships.
Conferring of Honorary Fellowships.
Installation of New Officers:
Second Vice President: Joe V. Meigs, M.D., F.A.C.S., Boston.
First Vice President: Owen H. Wangensteen, M.D., F.A.C.S., Minneapolis.
President: Daniel C. Elkin, M.D., F.A.C.S., Lancaster, Kentucky.
Address of the President: Daniel C. Elkin, M.D., F.A.C.S.
Recession.

Annual Meeting—Board of Governors

Sunday, 9:00 a.m.—5:00 p.m. (with Luncheon), Nob Hill Room, Fairmont Hotel

Charles C. Higgins, M.D., F.A.C.S., Cleveland; Chairman, Board of Governors, *Presiding.*

Minutes of the 1955 Annual Meeting of the Board of Governors. HOWARD H. BRADSHAW, M.D., F.A.C.S., Winston-Salem; Secretary, Board of Governors.
Report of the Chairman—Résumé of Interim Activities. CHARLES C. HIGGINS, M.D., F.A.C.S.
Report of the Executive Committee. HOWARD H. BRADSHAW, M.D., F.A.C.S.
Report of the President, WARREN H. COLE, M.D., F.A.C.S., Chicago.
Report of the Chairman, Board of Regents. I. S. RAVDIN, M.D., F.A.C.S., Philadelphia.
Report of the Director. PAUL R. HAWLEY, M.D., F.A.C.S., Chicago.
Report of Committee to Continue the Study of the Problem of Total Number of Governors of the College and of Their Distribution. DERYL HART, M.D., F.A.C.S., Durham, Chairman.
Report of Committee to Continue the Study of Itinerant Surgery and Surgeons. GEORGE W. WALDRON, M.D., F.A.C.S., Houston, Chairman.
Report of Committee to Study the Diminishing Number of Service Patients for Training Programs. CARL A. MOYER, M.D., F.A.C.S., St. Louis, Chairman.
Report of Committee to Study the Relationships Between the Medical Staffs and Governing Boards of Hospitals. JONATHAN E. RHOADS, M.D., F.A.C.S., Philadelphia, Chairman.
Announcements.

ADJOURNED MEETING—BOARD OF GOVERNORS

Thursday, 3:30—3:45 p.m., Polk Hall, Civic Auditorium

CHARLES C. HIGGINS, M.D., F.A.C.S., Chairman; *Presiding.*
Report of Nominating Committee on Election of Regents.
Election of Regents of College.
Report of Nominating Committee on Election of Officers, Board of Governors.
Election of Officers, Board of Governors.
Announcement of Committees, Board of Governors 1956–1957. Nominating Committee; Other Committees
Adjournment

Annual Meeting of Fellows

Thursday, 4:00—5:30 p.m., Arena, Civic Auditorium

WARREN H. COLE, M.D., F.A.C.S., Chicago; President, *Presiding.*
Report of the Chairman, Board of Regents. I. S. RAVDIN, M.D., F.A.C.S., Philadelphia.
Report of the Chairman, Board of Governors. CHARLES C. HIGGINS, M.D., F.A.C.S., Chicago.
Report of The Director of the College. PAUL R. HAWLEY, M.D., F.A.C.P., Chicago.
Present Status of Accreditation of Hospitals. NEWELL W. PHILPOTT, M.D., F.A.C.S., Montreal.
Actions of 1956 House of Delegates of American Medical Association. Relating to Practice of Surgery. WILLIAM L. ESTES, JR., Bethlehem, Pennsylvania.
Reports of the Committees on Nominations:
Election of Governors of the College; Chairman of the Nominating Committee of Fellows
Election of Regents of the College; Chairman of the Committee on Nominations, Board of Governors
Election of Officers of the College; Chairman of the Nominating Committee of Fellows
New Business
Adjournment

General Sessions

Monday, 10:00 a.m.—12:00 noon, Arena, Civic Auditorium

SURGERY OF THE ADRENAL GLANDS

Moderator: OLIVER COPE, M.D., F.A.C.S., Boston.
Collaborators: PETER H. FORSHAM, M.D., San Francisco; JAMES T. PRIESTLEY, M.D., F.A.C.S., Rochester, Minnesota; HAROLD A. ZINTEL, M.D., F.A.C.S., New York.

1:30—3:00 p.m., Arena, Civic Auditorium

PROPHYLAXIS IN DISSEMINATION AND IMPLANTATION OF CANCER

Moderator: WARREN H. COLE, M.D., F.A.C.S., Chicago.
Collaborators: LAUREN V. ACKERMAN, M.D., St. Louis; RUPERT TURNBULL, JR., M.D., F.A.C.S., Cleveland; JOHN M. WAUGH, M.D., F.A.C.S., Rochester, Minnesota; FRANK C. WHEELOCK, JR., M.D., F.A.C.S., Brookline, Massachusetts.

3:30—5:00 p.m., Arena, Civic Auditorium

HYPERTHYROIDISM

Moderator: BROWN M. DOBYNS, M.D., F.A.C.S., Cleveland

Collaborators: RICHARD B. CATTELL, M.D., F.A.C.S., Boston; HENRY H. SEARLS, M.D., F.A.C.S., San Francisco; PAUL STARR, M.D., F.A.C.P., Los Angeles.

Tuesday, 1:30—3:00 p.m., Arena, Civic Auditorium

PELVIC PAIN IN WOMEN

Moderator: LANGDON PARSONS, M.D., F.A.C.S., Boston.

Collaborators: OTTO AUFRANC, M.D., F.A.C.S., Boston; LAMAN A. GRAY, M.D., F.A.C.S., Louisville; KARL H. MARTZLOFF, M.D., F.A.C.S., Portland, Oregon; HENRY M. WEYRAUCH, M.D., F.A.C.S., San Francisco.

2:00—5:00 p.m., War Memorial, Veterans' Building

SYMPOSIUM ON TRAUMA

R. ARNOLD GRISWOLD, M.D., F.A.C.S., Louisville, *Presiding.*

Cranio-Cerebral Injuries. EVERETT G. GRANTHAM, M.D., F.A.C.S., Louisville.

Injuries to the Face and Neck. PAUL W. GREELEY, M.D., F.A.C.S., Chicago.

Injuries to the Thorax. PAUL C. SAMSON, M.D., F.A.C.S., Oakland.

Injuries to the Abdomen. HOWARD E. SNYDER, M.D., F.A.C.S., Winfield, Kansas.

Injuries to the Soft Tissues of the Extremities. OSCAR P. HAMPTON, JR., M.D., F.A.C.S., St. Louis.

Injuries to the Skeletal System. RALPH SOTO-HALL, M.D., F.A.C.S., San Francisco.

Priorities in Treatment. JOSEPH R. SHAEFFER, COL., M.C., U.S.A., F.A.C.S., Washington, D. C.

3:30—5:00 p.m., Arena, Civic Auditorium

SURGICAL MANAGEMENT OF DUODENAL ULCER

Moderator: JONATHAN E. RHOADS, M.D., F.A.C.S., Philadelphia.

Collaborators: JAMES D. HARDY, M.D., F.A.C.S., Jackson, Mississippi; HENRY N. HARKINS, M.D., F.A.C.S., Seattle; RICHARD WARREN, M.D., F.A.C.S., Boston; DONALD R. WEBSTER, M.D., F.A.C.S., Montreal.

Wednesday, 1:30—3:00 p.m., Arena, Civic Auditorium

HIATAL HERNIA AND ESOPHAGITIS

Moderator: STUART W. HARRINGTON, M.D., F.A.C.S., Rochester, Minnesota.

Collaborators: PHILIP R. ALLISON, F.R.C.S., F.A.C.S., Oxford, England; JOHN M. DORSEY, M.D., F.A.C.S., Evanston; ROBERT C. LAIRD, M.D., F.A.C.S., Toronto; HERBERT W. SCHMIDT, M.D., Rochester, Minnesota.

2:00—5:00 p.m., War Memorial, Veterans' Building

SYMPOSIUM ON CANCER

DANELY P. SLAUGHTER, M.D., F.A.C.S., Chicago, *Presiding.*

Explanation of Cancer Program of the American College of Surgeons. DANELY P. SLAUGHTER, M.D., F.A.C.S., Chicago.

Review of Current Status of Chemotherapy. JOSEPH H. BURCHENAL, M.D., New York.

Principles and Technique of Soft-Part Resection for Sarcomas. LEMUEL BOWDEN, M.D., F.A.C.S., New York.

Biometric Evaluation of Mammary Cancer. JOSEPH BERKSON, M.D., Rochester, Minnesota.

Diagnostic Significance of Lateral Tumors in the Neck. IAN MACDONALD, M.D., F.A.C.S., Los Angeles.

3:30—5:00 p.m., Arena, Civic Auditorium

WHAT ANTIBIOTICS SHOULD WE USE, AND WHEN?

Moderator: CHAMP LYONS, M.D., F.A.C.S., Birmingham.

Collaborators: CLAYTON H. CROSBY, M.D., F.A.C.S., Regina, Saskatchewan; WILLIAM T. FITTS, JR., M.D., F.A.C.S., Philadelphia; LOWELL A. RANTZ, M.D., F.A.C.P., San Francisco.

Thursday, 1:30—3:00 p.m., Arena, Civic Auditorium

BURNS

Moderator: JOHN D. MARTIN, JR., M.D., F.A.C.S., Emory University.

Collaborators: CURTIS P. ARTZ, LT. COL., M.C., U.S.A., F.A.C.S., Fort Sam Houston; T. G. BLOCKER, JR., M.D. F.A.C.S., Galveston; BOYD W. HAYNES, JR., M.D., F.A.C.S., Richmond, Virginia.

3:15 p.m.

ORATION ON TRAUMA

The Treatment of Open Wounds. MICHAEL L. MASON, M.D., F.A.C.S., Chicago.

Friday, 9:00 a.m.—12 noon, Polk Hall, Civic Auditorium
WHAT'S NEW IN SURGERY? (Forum Summary).
HARRIS B. SHUMACKER, JR., M.D., F.A.C.S., Indianapolis, *Presiding*.
Endocrinology, Metabolism, and Nutrition. JAMES D. HARDY, M.D., F.A.C.S., Memphis.
Urology. SAMUEL A. VEST, M.D., F.A.C.S., Charlottesville, Virginia.
Tumors. OWEN H. WANGENSTEEN, M.D., F.A.C.S., Minneapolis.
Neurosurgery. HOWARD C. NAFFZIGER, M.D., F.A.C.S., San Francisco.
Plastic. BRADFORD CANNON, M.D., F.A.C.S., Boston.
Cardiovascular Problems. ROBERT E. GROSS, M.D., F.A.C.S., Boston.

Surgical Specialties

GYNECOLOGY AND OBSTETRICS

Monday, 1:30—3:00 p.m., Peacock Court, Mark Hopkins Hotel
INDICATIONS AND TECHNIQUES IN INDUCTION OF LABOR
Moderator: JAMES L. REYCRAFT, M.D., F.A.C.S., Cleveland.
Collaborators: L. GRANT BALDWIN, M.D., F.A.C.S., Pasadena; BERNARD J. HANLEY, M.D., F.A.C.S., Los Angeles; J. BAY JACOBS, M.D., F.A.C.S., Washington, D. C.

3:30—5:00 p.m.
METABOLIC IMPACT OF SURGERY. RADIATION AND LABOR
Moderator: MILTON L. MCCALL, M.D., F.A.C.S., New Orleans.
Collaborators: GILBERT J. VOSBURGH, M.D., New York; JOHN A. WALL, M.D., F.A.C.S., Houston.

Tuesday, (GENERAL SESSIONS) 1:30–3:00 p.m., Arena, Civic Auditorium
PELVIC PAIN IN WOMEN (General Session)

3:30—5:00 p.m., Peacock Court, Mark Hopkins
CONTRASTED METHODS IN TREATMENT OF ABRUPTIO
Moderator: CONRAD COLLINS, M.D., F.A.C.S., New Orleans.
Collaborators: STANLEY M. BYSSHE, M.D., F.A.C.S., New York; HOBART M. KELLY, M.D., F.A.C.S., Riverside, California; CHARLES O. MCCORMICK, M.D., F.A.C.S., Indianapolis.

Wednesday, 1:30—3:00 p.m., Peacock Court, Mark Hopkins Hotel
PREMATURITY AND POSTMATURITY
Moderator: RUSSELL R. DE ALVAREZ, M.D., F.A.C.S., Seattle.
Collaborators: EMIL G. HOLMSTROM, M.D., Salt Lake City; J. G. MOORE, M.D., Los Angeles; KEITH P. RUSSELL, M.D., F.A.C.S., Los Angeles.

3:15—5:00 p.m.
SURGICAL FORUM SESSION

Thursday, 1:30–3:00 p.m., Peacock Court, Mark Hopkins Hotel
PERINEAL TRAUMA
Moderator: HAROLD L. GAINEY, M.D., F.A.C.S., Kansas City, Missouri.
Collaborators: ROBERT H. BARTER, M.D., F.A.C.S., Washington, D. C.; ALBERT DECKER, M.D., F.A.C.S., New York; EMIL J. KRAHULIK, M.D., F.A.C.S., Los Angeles.

Friday, 3:15—4:45 p.m., Terrace Room, Fairmont Hotel
SURGICAL STANDARDS IN TREATMENT OF CARCINOMA OF THE CERVIX
Moderator: ERLE HENRIKSEN, M.D., F.A.C.S., Los Angeles.
Collaborators: S. B. GUSBERG, M.D., F.A.C.S., New York; GEORGE F. MELODY, M.D., F.A.C.S., San Francisco; JAMES F. NOLAN, M.D., F.A.C.S., Los Angeles.

NEUROLOGIC SURGERY

Thursday, 9:00 a.m.—12 noon, Peacock Court, Mark Hopkins Hotel
SURGICAL FORUM SESSION

Friday, 9:00—10:30 a.m., Peacock Court, Mark Hopkins Hotel

SURGICAL MANAGEMENT OF INTRACRANIAL ANEURYSMS AND ARTERIOVENOUS MALFORMATIONS

Moderator: Russell Meyers, M.D., F.A.C.S., Iowa City.

Collaborators: Wallace B. Hamby, M.D., F.A.C.S., Buffalo; Carl F. List, M.D., F.A.C.S., Grand Rapids; Francis Murphey, M.D., Memphis.

10:30 a.m—12 noon

SURGICAL MANAGEMENT OF CEREBROVASCULAR DISEASE

Moderator: E. S. Gurdjian, M.D., F.A.C.S., Detroit.

Collaborators: Edwin B. Boldrey, M.D., F.A.C.S., San Francisco; Hendrik J. Svien, M.D., F.A.C.S., Rochester, Minnesota; William H. Sweet, M.D., F.A.C.S., Boston.

1:30—4:45 p.m., Peacock Court, Mark Hopkins Hotel

NEUROSURGERY SYMPOSIUM

ORTHOPEDIC SURGERY

Wednesday, 2:00—5:00 p.m., Fairmont Hotel

SURGICAL FORUM SESSION

Friday, 1:30—3:00 p.m., Gold Room, Fairmont Hotel

FRACTURES OF TARSAL AND METATARSAL BONES

Moderator: E. George Chuinard, M.D., F.A.C.S., Portland, Oregon.

Collaborators: Charles W. Goff, M.D., F.A.C.S., Hartford; Harry Winkler, M.D., F.A.C.S., Charlotte, N. C.

3:15—4:45 p.m., Fairmont Hotel

DIFFERENTIAL DIAGNOSIS AND TREATMENT OF LOW BACK PAIN AND SCIATICA

Moderator: Guy A. Caldwell, M.D., F.A.C.S., New Orleans.

Collaborators: Francis J. Cox, M.D., F.A.C.S., San Francisco; Leo S. Lucas, M.D., F.A.C.S., Portland, Oregon.

OPHTHALMOLOGY

Wednesday, 2:00—5:00 p.m., Nob Hill Theater, Fairmont Hotel

SYMPOSIUM: Aspects of Extraocular Surgery. Arthur J. Jampolsky, M.D., F.A.C.S., San Francisco.

The Therapeutic Uses of Corneal Transplantation. Max Fine, M.D., San Francisco.

Surgical Pathology Symposium:

Arranged by Michael J. Hogan, M.D., San Francisco.

Pathologic Studies on Postoperative Narrow Angle Glaucoma Eyes. Michael J. Hogan, M.D., San Francisco.

Clinico-pathologic Studies on Operative and Postoperative Massive Choroidal Hemorrhage. Levon K. Garron, M.D., F.A.C.S., Oakland.

Psychologic Aspects of Enucleation and the Management of Patients Undergoing Such Surgery. Frederick R. Carriker, M.D., Denver.

OTOLARYNGOLOGY

Thursday, 1:15—3:15 p.m., Nob Hill Theater, Fairmont Hotel

SYMPOSIUM: MOBILIZATION OF THE STAPES IN OTOSCLEROSIS

Moderator: Howard P. House, M.D., F.A.C.S., Los Angeles.

Participants: Shirley Harold Baron, M.D., F.A.C.S., San Francisco; Richard J. Bellucci, M.D., F.A.C.S., New York; Victor Goodhill, M.D., F.A.C.S., Los Angeles; Howard P. House, M.D., F.A.C.S., Los Angeles; Francis A. Sooy, M.D., San Francisco.

PLASTIC SURGERY

Thursday, 2:00—5:00 p.m., Gold Room, Fairmont Hotel

SURGICAL FORUM SESSION

Friday, 1:30—3:00 p.m., Venetian Room, Fairmont Hotel

RECONSTRUCTIVE SURGERY OF THE NECK

Moderator: DONALD M. GLOVER, M.D., F.A.C.S., Cleveland.

Collaborators: SIDNEY E. BLANDFORD, M.D., F.A.C.S., Denver; BRADFORD CANNON, M.D., F.A.C.S., Boston; HERBERT CONWAY, M.D., F.A.C.S., New York; FRANK F. KANTHAK, M.D., F.A.C.S., Atlanta; WILLIAM F. MACFEE, M.D., F.A.C.S., New York; HENRY S. PATTON, M.D., F.A.C.S., Oakland.

3:15—4:45 p.m.

RECONSTRUCTIVE SURGERY OF THE EYELIDS AND ORBITAL REGION

Moderator: WILLIAM S. KISKADDEN, M.D., F.A.C.S., Los Angeles.

Collaborators: MCCARTHY DEMERE, M.D., F.A.C.S., Memphis; CLIFFORD L. KIEHN, M.D., F.A.C.S., Cleveland; DOUGLAS W. MACOMBER, M.D., F.A.C.S., Denver; W. BRANDON MACOMBER, M.D., F.A.C.S., Albany; DAVID W. ROBINSON, M.D., F.A.C.S., Kansas City, Kansas; WILLARD D. ROWLAND, M.D., F.A.C.S., Portland, Oregon.

THORACIC SURGERY

Friday, 1:30—3:00 p.m., Empire Room, Sir Francis Drake Hotel

SELECTIVE PULMONARY RESECTION

Moderator: ROBERT R. SHAW, M.D., F.A.C.S., Dallas.

Collaborators: J. MAXWELL CHAMBERLIN, M.D., F.A.C.S., New York; WILLIAM S. CONKLIN, M.D., F.A.C.S., Portland, Oregon; PAUL W. GEBAUER, M.D., F.A.C.S., Augusta, Georgia; ROBERT C. MAJOR, M.D., F.A.C.S., Augusta, Georgia.

3:15—4:45 p.m.

RECENT DEVELOPMENTS IN CARDIAC SURGERY

Moderator: ALFRED BLALOCK, M.D., F.A.C.S., Baltimore.

Collaborators: F. HENRY ELLIS, JR., M.D., F.A.C.S., Rochester, Minnesota; EMILE HOLMAN, M.D., F.A.C.S., San Francisco; WILLIAM H. MULLER, JR., M.D., F.A.C.S., Charlottesville, Virginia.

UROLOGY

Monday, 3:30—5:00 p.m., Room 301, Civic Auditorium

HYPOSPADIAS

Moderator: EDGAR BURNS, M.D., F.A.C.S., New Orleans.

Collaborators: ORMOND S. CULP, M.D., F.A.C.S., Rochester, Minnesota; DONALD R. SMITH, M.D., F.A.C.S., San Francisco.

Tuesday, 1:30—3:00 p.m., Room 301, Civic Auditorium

EVALUATION OF ISOTOPES IN THE TREATMENT OF CARCINOMA OF THE PROSTATE AND BLADDER

Moderator: VINCENT J. O'CONOR, M.D., F.A.C.S., Chicago.

Collaborators: MARSHALL H. BRUCER, M.D., Oak Ridge, Tennessee; RUBIN H. FLOCKS, M.D., F.A.C.S., Iowa City; FRANK HINMAN, JR., M.D., F.A.C.S., San Francisco; HENRY L. JAFFE, M.D., Los Angeles.

Wednesday, 1:30—3:00 p.m., Room 301, Civic Auditorium

SURGICAL INJURIES OF THE LOWER URINARY TRACT

Moderator: WILLIAM NILES WISHARD, JR., M.D., F.A.C.S., Indianapolis, Indiana.

Collaborators: RALPH C. BENSON, M.D., F.A.C.S., Portland, Oregon; GRAYSON CARROLL, M.D., F.A.C.S., St. Louis; DAVID A. CULP, M.D., F.A.C.S., Iowa City; DANIEL R. HIGBEE, M.D., Denver.

Thursday, 9:00 a.m.—12 noon, Room 301, Civic Auditorium

SURGICAL FORUM SESSION

Friday, 1:30—3:00 p.m., Nob Hill Room, Fairmont Hotel

MANAGEMENT OF OBSTRUCTIONS OF THE UPPER URINARY TRACT

Moderator: REED M. NESBIT, M.D., F.A.C.S., Ann Arbor.

Collaborators: THOMAS E. GIBSON, M.D., F.A.C.S., San Francisco; MILES GRIFFIN, M.D., F.A.C.S., Oakland; FRANK C. HAMM, M.D., F.A.C.S., Brooklyn; FREDERICK C. SCHLUMBERGER, M.D., F.A.C.S., Beverly Hills.

Postgraduate Courses

PREOPERATIVE AND POSTOPERATIVE CARE

HENRY T. RANDALL, M.D., F.A.C.S., New York, *Chairman.*

Monday, 8:30—11:30 a.m., Larkin Hall Annex, Civic Auditorium

FUNDAMENTAL PRINCIPLES OF NUTRITION, FLUID, AND ELECTROLYTE BALANCE

FRANCIS D. MOORE, M.D., F.A.C.S., Boston, *Moderator.*

Milliequivalent, Millimole, and Milliosmole—What They Are. What Are "Normal Values" in Blood, Urine, Diet in Milliequivalents? Size and Function of Body Compartments. HENRY T. RANDALL, M.D., F.A.C.S., New York.

Normal Mechanism for Handling Acid and Base Loads. The Role of the Kidneys, the Respiratory and Gastrointestinal Tracts. HAROLD G. BARKER, M.D., F.A.C.S., New York.

Basic Requirements of the Patient Undergoing Surgery for Water, Electrolytes, Calories, Nitrogen. The Role of Age, Sex, Fever, Sweating, and Environment in Modifying These Requirements. ROBERT E. L. BERRY, M.D., F.A.C.S., Ann Arbor.

Extrarenal Losses of Water and Electrolytes, Their Replacement. The "Third Space Effect" of Trauma, Burns, Wounds, and Its Management. WILLIAM E. ABBOTT, M.D., F.A.C.S., Cleveland.

Dehydration and Electrolyte Depletion in the Preoperative Patients; Its Diagnosis and Management Before and During Surgery. CARL A. MOYER, M.D., F.A.C.S., St. Louis.

The Preparation of the Patient in Shock for Surgery. JOHN M. HOWARD, M.D., F.A.C.S., Atlanta.

Hypothermia in the Preparation of the Poor Risk Patient for Surgery. JACK M. FARRIS, M.D., F.A.C.S., Los Angeles.

The Medical Evaluation of the Patient as a Surgical Risk: (1) Routine; (2) Emergency. GEORGE B. ROBSON, M.D., San Francisco.

Tuesday, 8:30—11:30 a.m., Larkin Hall Annex, Civic Auditorium

FUNDAMENTAL PRINCIPLES OF NUTRITION, FLUID, AND ELECTROLYTE BALANCE

WALTER G. MADDOCK, M.D., F.A.C.S., Chicago, *Moderator.*

Use and Abuse of Transfusions in Surgical Patients—Role of the Blood Volume. CHAMP LYONS, M.D., F.A.C.S., Birmingham.

Role of Plasma Volume Expanders in Surgical Patients; Type, Indications, Complications. JONATHAN E. RHOADS, M.D., F.A.C.S., Philadelphia.

Factors Influencing Bleeding and Clotting in Surgical Patients. Management of Patients With Excessive Oozing. EUGENE E. CLIFFTON, M.D., New York.

Management of Early Burn. CURTIS P. ARTZ, M.D., F.A.C.S., Lieutenant Colonel, Fort Sam Houston.

The Ten Commonest Patterns of Water and Electrolyte Abnormality in Surgery. FRANCIS D. MOORE, M.D., F.A.C.S., Boston.

The Response of the Patient to Trauma:

Surgeon's Concept of the Alarm Response. Neuroendocrine Response to Nausea, Stress, Surgery. Indications and Contraindications for the Use of Steroids in the Surgical Patient. The Addison's Disease Patient, Adrenalectomy, Drug Reactions. Surgical Adrenal Exhaustion. DAVID M. HUME, M.D., F.A.C.S., Boston.

Effect of Trauma on Metabolism of Water and Electrolytes. WALTER G. MADDOCK, M.D., F.A.C.S., Chicago.

Effect of Trauma on Requirements for Calories, Nitrogen. Practical Methods of Administration. ROBERT ELMAN, M.D., F.A.C.S., St. Louis.

Wednesday, 8:30—11:30 a.m., Larkin Hall Annex, Civic Auditorium

MANAGEMENT OF PREOPERATIVE AND POSTOPERATIVE PROBLEMS AND COMPLICATIONS OF VARIOUS TYPES OF SURGERY

WILLIAM E. ABBOTT, M.D., F.A.C.S., Cleveland, *Moderator.*

Gastrointestinal Tract Surgery:

Nutritional Problems in Patient Undergoing Gastric Surgery. ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus, Ohio.

Management of Patient with Intestinal Obstruction: with Ileus. Use and Abuse of Intestinal Suction. Small Bowel Fistulas. Ileostomy. HORACE J. MCCORKLE, M.D., F.A.C.S., San Francisco.

Preparation of Patient for Large Bowel Surgery. Antibiotics. Effect of Preoperative Purgation. Management of Diarrhea. JOHN M. BEAL, M.D., F.A.C.S., New York.

Problems Resulting from Ureterointestinal Anastomoses:

Mechanisms of Development of Hyperchloremic Acidosis and its Management. Experiences with Bladder Substitutes. D. ALAN MCAFEE, M.D., F.A.C.S., St. Louis.

Thoracic and Cardiac Surgery:

Preoperative Evaluation and Postoperative Care of Patients Undergoing Thoracic Surgery. GEORGE H. A. CLOWES, M.D., Cleveland.

Particular Problems of Patients Undergoing Cardiac Surgery with Regard to Water and Electrolyte Balance. RUSSELL M. NELSON, M.D., Salt Lake City, Utah.

Thursday, 8:30—11:30 a.m., Larkin Hall Annex, Civic Auditorium

MANAGEMENT OF PREOPERATIVE AND POSTOPERATIVE PROBLEMS AND COMPLICATIONS OF VARIOUS TYPES OF SURGERY

FRASER N. GURD, M.D., F.A.C.S., Montreal, *Moderator.*

Surgical Infection:

The Operating Room and Dressing Techniques as Surgical Hazards. CARL W. WALTER, M.D., F.A.C.S., Boston.

Selection and Use of Antibiotics in Surgical Patients. EDWIN J. PULASKI, M.D., F.A.C.S., Lieutenant Colonel, Honolulu.

Management of Patient with Hepatic Failure, Acidosis, Ascites, and Hepatic Coma. HENRY T. RANDALL, M.D., F.A.C.S., New York.

Differential Diagnosis and Management of Hypotension in Surgical Patients. FRASER N. GURD, M.D., F.A.C.S., Montreal.

Diagnosis and Treatment of Acute Renal Failure. J. MAX RUKES, M.D., San Francisco.

GASTROINTESTINAL TRACT

WILLIAM P. LONGMIRE, JR., M.D., F.A.C.S., Los Angeles, *Chairman.*

Monday, 8:30—11:30 a.m., Empire Room, Sir Francis Drake Hotel

MARK M. RAVITCH, M.D., F.A.C.S., Baltimore, *Presiding.*

Management of Pyloric Stenosis in Infants. WILLIAM J. NORRIS, M.D., F.A.C.S., Los Angeles.

Mediastinal Lesions in Infants. LYMAN A. BREWER, M.D., F.A.C.S., Los Angeles.

Intestinal Obstruction in Infants and Children. EDWARD W. GERRISH, M.D., F.A.C.S., Cleveland.

Fluid and Electrolyte Therapy in Infants. MARK M. RAVITCH, M.D., F.A.C.S., Baltimore.

Benign Lesions of the Esophagus; Achalasia, Stricture Tumors, Esophagitis. K. ALVIN MERENDINO, M.D., F.A.C.S., Seattle.

Diaphragmatic Hernia. ORVILLE F. GRIMES, M.D., F.A.C.S., San Francisco.

Tuesday, 8:30—11:30 a.m., Empire Room, Sir Francis Drake Hotel

HENRY N. HARKINS, M.D., Seattle, *Presiding.*

Gastric Physiology Related to Surgical Concepts. LESTER R. DRAGSTEDT, M.D., F.A.C.S., Chicago.

Management of Gastric Ulcer: Medical Aspects. ALBERT M. SNELL, M.D., A.C.P., Palo Alto; Surgical Aspects. I. S. RAVDIN, M.D., F.A.C.S., Philadelphia.

Unusual Cases of Gastrointestinal Bleeding and Their Treatment. JAMES V. MALONEY, JR., M.D., Los Angeles.

Panel: Treatment of Duodenal Ulcer. (1) Subtotal Resection. ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus; (2) Vagotomy. JOSEPH A. WEINBERG, M.D., F.A.C.S., Long Beach; (3) Hemigastrectomy and Vagotomy. REGINALD H. SMITHWICK, M.D., Boston.

Wednesday, 8:30—11:30 a.m., Empire Room, Sir Francis Drake Hotel

CLARENCE DENNIS, M.D., F.A.C.S., Brooklyn, *Presiding.*

Rectal Carcinoma. R. KENNEDY GILCHRIST, M.D., F.A.C.S., Chicago.

Antibiotics in Abdominal Surgery. CHAMP LYONS, M.D., F.A.C.S., Birmingham.

The Modification of Endocrine Activity by Surgical Trauma. FRANCIS D. MOORE, M.D., F.A.C.S., Boston.

Parenteral Nutrition. JAMES D. HARDY, M.D., F.A.C.S., Jackson, Mississippi.

Gastrointestinal Intubation. GRAFTON A. SMITH, M.D., Minneapolis.

Perforated Peptic Ulcer: Primary Suture. CLAUDE E. WELCH, M.D., F.A.C.S.; Primary Resection. DENTON A. COOLEY, M.D., F.A.C.S., Houston.

Thursday, 8:30—11:30 a.m., Empire Room, Sir Francis Drake Hotel

WILLIAM P. LONGMIRE, JR., M.D., F.A.C.S., Los Angeles, *Presiding.*

Segmental Enteritis. VICTOR RICHARDS, M.D., F.A.C.S., San Francisco.

Diverticulitis. ALLEN M. BOYDEN, M.D., F.A.C.S., Portland.
Current Concepts in the Management of Appendicitis. CLARENCE J. BERNE, M.D., F.A.C.S., Los Angeles.
Colonic Fistulas (External, gastric, enteric, vesicle). R. B. TURNBULL, M.D., F.A.C.S., Cleveland.
Benign Rectal Lesions. RAYMOND J. JACKMAN, M.D., Rochester, Minnesota.
Selected Cases for Massive Gastrointestinal Resection. JOHN M. BEAL, M.D., F.A.C.S., New York.

DISEASES OF THE LIVER, BILIARY TRACT, AND PANCREAS

J. ENGLEBERT DUNPHY, M.D., F.A.C.S., Boston, *Chairman.*

Monday, 8:30—11:30 a.m., Nob Hill Room, Fairmont Hotel

EXPERIMENTAL AND CLINICAL ADVANCES IN SURGERY OF THE LIVER

C. STUART WELCH, M.D., F.A.C.S., Albany, *Moderator.*
Resection of the Liver with Particular Reference to Right Hepatic Lobectomy. IRVING M. ARIEL, M.D., F.A.C.S., New York.
Hepatic Coma and the Metabolism of Ammonia. BEN EISEMAN, M.D., F.A.C.S., Denver.
The Immediate Treatment of Bleeding from Esophageal Varices. C. STUART WELCH, M.D., F.A.C.S., Albany.
Portography in Portal Hypertension. LOUIS M. ROUSSELOT, M.D., F.A.C.S., New York.
Surgical Treatment of Ascites.

Tuesday, 8:30—11:30 a.m., Nob Hill Room, Fairmont Hotel

GALLSTONES AND THEIR COMPLICATIONS

J. ENGLEBERT DUNPHY, M.D., F.A.C.S., Boston, *Moderator.*
Asymptomatic Gallstone. JOEL W. BAKER, M.D., F.A.C.S., Seattle.
Acute Pancreatitis as a Complication of Biliary Tract Disease. CARLETON MATHEWSON, JR., M.D., F.A.C.S., San Francisco.
Acute Cholecystitis. MARSHALL K. BARTLETT, M.D., F.A.C.S., Boston.
Gallstones and Obstructive Jaundice. FRANK GLENN, M.D., F.A.C.S., New York.
Hepatorenal Syndrome. J. ENGLEBERT DUNPHY, M.D., F.A.C.S., Boston.

Wednesday, 8:30—11:30 a.m., Nob Hill Room, Fairmont Hotel

PRESENT STATUS OF PANCREATIC SURGERY

JAMES T. PRIESTLEY, M.D., F.A.C.S., Rochester, *Moderator.*
Surgical Anatomy of the Pancreas. W. HENRY HOLLINSHEAD, M.D., Rochester, Minnesota.
Treatment of Acute Pancreatitis. JONATHAN E. RHOADS, M.D., F.A.C.S., Philadelphia.
The Pancreas as Protector of the Liver. I. L. CHAIKOFF, M.D., Berkeley.
Cancer of the Pancreas. RICHARD B. CATTELL, M.D., F.A.C.S., Boston.
Hyperinsulinism. JAMES T. PRIESTLEY, M.D., F.A.C.S., Rochester.
Retrograde Drainage in the Surgical Treatment of Pancreatitis. EDWIN H. ELLISON, M.D., F.A.C.S., Columbus.
Pathologic Physiology of the Pancreas. HENRY DOUBILET, M.D., F.A.C.S., New York.

Thursday, 8:30—11:30 a.m., Nob Hill Room, Fairmont Hotel

TECHNICAL PROBLEMS IN BILIARY AND PANCREATIC SURGERY

ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus, *Moderator.*
Safe Cholecystectomy. FRANK GLENN, M.D., F.A.C.S., New York.
Technical Aspects of Surgery for Acute Cholecystitis. LEON GOLDMAN, M.D., F.A.C.S., San Francisco.
Pitfalls Due to Anatomic Variations of the Biliary Tract. FREDERICK COLLER, M.D., F.A.C.S., Ann Arbor, Michigan.
Techniques in the Repair of Strictures of the Common Duct. HARRIS B. SHUMACKER, JR., M.D., F.A.C.S., Indianapolis.
Surgical Techniques in the Treatment of Chronic Pancreatitis. RICHARD B. CATTELL, M.D., F.A.C.S., Boston.
Technique of Exploration of the Common Duct. ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus.

CARDIOVASCULAR SURGERY

F. A. SIMEONE, M.D., F.A.C.S., Cleveland, *Chairman.*

Monday, 8:30—11:30 a.m., Venetian Room, Fairmont Hotel

MANAGEMENT OF WOUNDS AND DISEASES OF THE ARTERIES

F. A. SIMEONE, M.D., F.A.C.S., Cleveland, *Moderator.*
Clinical Patterns and the Diagnosis of Peripheral Arterial Disease. WILLIAM D. HOLDEN, M.D., F.A.C.S., Cleveland.

Collateral Circulation in Arterial Disease and Trauma. LEWIS H. BOSHER, JR., M.D., F.A.C.S., Richmond, Virginia.
Management of Acute Arterial Wounds. LT. COL. CARL W. HUGHES, M.D., Washington, D. C.
Basic Concepts in the Management of Arterial Aneurysms and Arteriovenous Fistulas. EMILE HOLMAN, M.D., F.A.C.S., San Francisco.
Sympathectomy in Peripheral Arterial Disease. HARRIS B. SHUMACKER, JR., M.D., F.A.C.S., Indianapolis, Indiana.
Methods for Re-establishing Arterial Continuity in Occlusive Disease of the Arteries. CHARLES A. HUFNAGEL, M.D., F.A.C.S., Washington, D. C.

Tuesday, 8:30—11:30 a.m., Venetian Room, Fairmont Hotel
MANAGEMENT OF WOUNDS AND DISEASES OF THE VEINS
RICHARD WARREN, M.D., F.A.C.S., Boston, *Moderator.*
Varicose Veins. ROBERT R. LINTON, M.D., F.A.C.S., Brookline, Massachusetts.
Venous Thrombosis and Pulmonary Embolism. H. ROCKE ROBERTSON, M.D., F.A.C.S., Vancouver, B. C.
Physiology of Chronic Venous Disorders of the Legs. PAUL T. DECAMP, M.D., F.A.C.S., New Orleans.
Postphlebitic Syndrome. CARL A. MOYER, M.D., F.A.C.S., St. Louis.
Portal Hypertension. CHARLES GARDNER CHILD, III, M.D., F.A.C.S., Boston.
Venous and Lymphatic Problems of the Arms. RALPH A. DETERLING, JR., M.D., F.A.C.S., New York.

Wednesday, 8:30—11:30 a.m., Venetian Room, Fairmont Hotel
CONGENITAL HEART DISEASE
HENRY SWAN, M.D., F.A.C.S., Denver, *Moderator.*
Coarctation and Anomalies of the Great Vessels. FRANK GLENN, M.D., F.A.C.S., New York.
Pulmonary Valvular Stenosis. H. WILLIAM SCOTT, JR., M.D., F.A.C.S., Nashville.
Interatrial Septal Defect. F. JOHN LEWIS, M.D., F.A.C.S., Minneapolis.
Tetralogy of Fallot. JULIAN JOHNSON, M.D., F.A.C.S., Philadelphia.
Panel: Open Heart Surgery.
Moderator: HENRY SWAN, M.D., F.A.C.S., Denver.
Participants: F. HENRY ELLIS, JR., M.D., F.A.C.S., Rochester, Minnesota; C. WALTON LILLEHEI, M.D., F.A.C.S., Minneapolis; ORMAND C. JULIAN, M.D., F.A.C.S., Chicago; CONRAD R. LAM, M.D., F.A.C.S., Detroit.

Thursday, 8:30—11:30 a.m., Venetian Room, Fairmont Hotel
ACQUIRED HEART DISEASE
HENRY SWAN, M.D., F.A.C.S., Denver, *Moderator.*
Mitral Stenosis. FRANK GERBODE, M.D., F.A.C.S., San Francisco.
Mitral Regurgitation. DWIGHT E. HARKEN, M.D., F.A.C.S., Boston.
Aortic Stenosis. JULIO C. DAVILA, M.D., Philadelphia.
Aortic Regurgitation. CHARLES A. HUFNAGEL, M.D., F.A.C.S., Washington, D. C.
Panel: Coronary Heart Disease.
Moderator: HENRY SWAN, M.D., F.A.C.S., Denver.
Participants: JAMES H. WALKER, M.D., F.A.C.P., Charleston, West Virginia; ALVIN A. BAKST, M.D., Brooklyn; EDWARD E. AVERY, M.D., F.A.C.S., Chicago; BERNARD L. BROFMAN, M.D., Cleveland.

FRACTURES AND DISLOCATIONS

FLOYD H. JERGESEN, M.D., F.A.C.S., San Francisco, *Chairman.*

Monday, 8:30—11:30 a.m., Rooms 301-303, Civic Auditorium
FRACTURES OF THE TIBIA
HARRISON L. MCLAUGHLIN, M.D., F.A.C.S., New York, *Moderator.*
Management of Stable Fractures and Fractures in Children. BARBARA B. STIMSON, M.D., F.A.C.S., Poughkeepsie, New York.
Management of Unstable Fractures (All Types). OSCAR P. HAMPTON, JR., M.D., F.A.C.S., St. Louis.
Management of Open Fractures. GEORGE J. CURRY, M.D., F.A.C.S., Flint, Michigan.
Management of Delayed Union and Nonunion. PRESTON A. WADE, M.D., F.A.C.S., New York.

Tuesday, 8:30—11:30 a.m., Rooms 301-303, Civic Auditorium
FRACTURES AND DISLOCATIONS OF THE ANKLE
OSCAR P. HAMPTON, JR., M.D., F.A.C.S., St. Louis, *Moderator.*
The Bony and Ligamentous Support About the Ankle. J. B. DE C. M. SAUNDERS, M.D., San Francisco.
The Pathology of Fracture Dislocations at the Ankle. HARRISON L. MCLAUGHLIN, M.D., F.A.C.S., New York.
The Closed or Nonoperative Management of Fractures and Dislocations at the Ankle. WILLIAM T. FITTS, JR., M.D., F.A.C.S., Philadelphia.

The Operative or Open Management of Fractures and Dislocations of the Ankle. HAROLD A. SOFIELD, M.D., F.A.C.S., Oak Park, Illinois.

Wednesday, 8:30—11:30 a.m., Rooms 301–303, Civic Auditorium

FRACTURES OF THE FEMORAL SHAFT OR NECK

Moderator: DONALD E. KING, M.D., F.A.C.S., San Francisco.

Collaborators: FLOYD H. JERGESON, M.D., F.A.C.S., San Francisco; WILLIAM H. BICKEL, M.D., F.A.C.S., Rochester, Minnesota; CARROLL B. LARSON, M.D., F.A.C.S., Iowa City.

Thursday, 8:30—11:30 a.m., Rooms 301–303, Civic Auditorium

FRACTURES AND DISLOCATIONS OF THE ELBOW

Moderator: LEONARD T. PETERSON, M.D., F.A.C.S., Washington, D. C.

Collaborators: FRANCIS E. WEST, M.D., F.A.C.S., San Diego; JUSTUS PICKETT, M.D., F.A.C.S., Morgantown, W.Va.

GYNECOLOGY AND OBSTETRICS

PHILIP H. ARNOT, M.D., F.A.C.S., San Francisco, *Chairman.*

Monday, 8:30—11:30 a.m., Room of the Dons, Mark Hopkins Hotel

PHILIP H. ARNOT, M.D., F.A.C.S., San Francisco, *Moderator.*

The Female Urethra as a Gynecologic Problem. GEORGE E. JUDD, M.D., F.A.C.S., Los Angeles.

Colposcopy. WARREN R. LANG, M.D., F.A.C.S., Philadelphia.

Surgical Complications of Pregnancy. ROBERT H. BARTER, M.D., F.A.C.S., Washington, D. C.

Varicose Veins in Pregnancy. JOSEPH S. MCGUINNESS, M.D., F.A.C.S., San Francisco.

Tuesday, 8:30—11:30 a.m., Room of the Dons, Mark Hopkins Hotel

PHILIP H. ARNOT, M.D., F.A.C.S., San Francisco, *Moderator.*

Changing Concepts in the Treatment of Uterine Carcinoma. HERBERT F. TRAUT, M.D., F.A.C.S., San Francisco.

Heart Disease in Pregnancy. CURTIS J. LUND, M.D., Rochester, New York.

The Problem of Cancer of the Cervix in Pregnancy. ROBERT W. KISTNER, M.D., F.A.C.S., Brookline, Massachusetts.

Wednesday, 8:30—11:30 a.m., Room of the Dons, Mark Hopkins Hotel

JOE VINCENT MEIGS, M.D., F.A.C.S., Boston, *Moderator.*

Gynecology in the Young. GOODRICH C. SCHAUFFLER, M.D., Portland, Oregon.

Gynecologic Care of the Aged. R. GLENN CRAIG, M.D., F.A.C.S., San Francisco.

Diabetes and Pregnancy. DONALD R. NELSON, M.D., F.A.C.S., San Francisco.

Thursday, 8:30—11:30 a.m., Room of the Dons, Mark Hopkins Hotel

PHILIP H. ARNOT, M.D., F.A.C.S., San Francisco, *Moderator.*

Panel Discussion: New Developments in the Physiology and Therapy of Toxemia. ERNEST W. PAGE, M.D., Berkeley; RUSSELL R. DEALVAREZ, M.D., F.A.C.S., Seattle; MILTON L. MCCALL, M.D., F.A.C.S., New Orleans.

Panel Discussion: Thyroid Disease in Pregnancy. KEITH P. RUSSELL, M.D., F.A.C.S., Los Angeles.

Panel Discussion: Premenstrual Tension; the Cause and Cure. ERLE HENRIKSEN, M.D., F.A.C.S., Los Angeles.

Friday, 8:30—11:30 a.m., Room of the Dons, Mark Hopkins Hotel

BERNARD J. HANLEY, M.D., F.A.C.S., Los Angeles, *Moderator.*

Panel Discussion: Diagnosis and Therapy of Abnormal Uterine Bleeding. CHARLES E. MCLENNAN, M.D., San Francisco; EMIL G. HOLMSTROM, M.D., Salt Lake City; J. G. MOORE, M.D., Los Angeles.

Panel Discussion: Recent Advances in Renal Physiology. HAROLD A. HARPER, PH.D., San Francisco.

Panel Discussion. The Occipito-Posterior Position. PHILIP H. ARNOT, M.D., F.A.C.S., San Francisco.

ORTHOPEDIC SURGERY

FREDERIC C. BOST, M.D., F.A.C.S., San Francisco, *Chairman.*

Monday, 8:30—11:30 a.m., Rooms A, E, and B, Mark Hopkins Hotel

A SYMPOSIUM ON SCOLIOSIS

JOSEPH C. RISSER, M.D., Pasadena, California, *Moderator.*

Introduction. JOSEPH C. RISSER, M.D., Pasadena, California.

Early Recognition and the Early Treatment of the Scoliotic. C. H. LAUDER, JR., M.D., Pasadena, California.

Correction of the Scoliotic. B. RANDOLPH COCKRELL, JR., M.D., Pasadena, California.

Demonstration and Application of the Corrective Body Cast. DOCTORS RISSER, NORQUIST, LAUDER, and COCKRELL, Pasadena, California.

Explanation of Failures. Short Fusions. Long Fusions. Pseudoarthrosis. DONALD M. NORQUIST, M.D., Pasadena, California.

Tuesday, 8:30—11:30 a.m., Rooms A, E, and B, Mark Hopkins Hotel

THE SURGICAL TREATMENT OF COMMON DISORDERS OF THE HAND

L. D. HOWARD, JR., M.D., F.A.C.S., San Francisco, *Moderator.*

Introductory Remarks. STERLING BUNNELL, M.D., San Francisco.

Acute Tendon and Nerve Injuries of the Hand (with Motion Picture). L. D. HOWARD, JR., M.D., F.A.C.S., San Francisco.

Composite Hand Injuries; Their Management (Lantern Slide Illustrations). L. D. HOWARD, JR., M.D., F.A.C.S., DONALD R. PRATT, M.D., CARRUTH J. WAGNER, M.D., F.A.C.S., San Francisco.

Wednesday, 8:30—11:30 a.m., Rooms A, E, and B, Mark Hopkins Hotel

THE SURGICAL TREATMENT OF COMMON DISORDERS OF THE FOOT

ROBERT J. JOPLIN, M.D., F.A.C.S., Brookline, Massachusetts, *Moderator.*

Treatment of the Calcaneal Cavus Foot. E. EDWIN IRWIN, M.D., Atlanta.

Surgical Correction of the Valgus Foot. DAVID STEPHEN GRICE, M.D., Boston.

Etiology of Peroneal Spastic Flat Foot. ROBERT I. HARRIS, M.B., F.R.C.S.(C)., Toronto.

Treatment of Deformities of the Forefoot. Primus Varus. Hallux Valgus. Splayfoot. Metatarsalgia. Atavistic First Metatarsal and Hammertoe. ROBERT J. JOPKIN, M.D., F.A.C.S., Brookline, Massachusetts.

Thursday, 8:30—11:30 a.m., Rooms A, E, and B, Mark Hopkins Hotel

THE SURGICAL TREATMENT OF ARTHRITIS DEFORMANS OF THE HIP. SYMPOSIUM.

RALPH SOTO-HALL, M.D., F.A.C.S., San Francisco, *Moderator.*

Pathology and Causes of Arthritis Deformans.

Anatomy of Surgical Approaches of the Hip.

Methods of Surgical Treatment:

Osteotomy.

Arthroplasty (acetabuloplasty, prosthesis, cup).

Arthrodesis.

Treatment of Complications.

Physical Therapy and Rehabilitation of Arthroplasty Cases.

Participants: ROBERT W. BAILEY, M.D., Los Angeles; LEONARD B. BARNARD, M.D., Oakland; JAMES VERNON LUCK, M.D., Los Angeles; RALPH SOTO-HALL, M.D., San Francisco; JAMES E. M. THOMSON, M.D., Lincoln, Nebraska.

SURGICAL ASPECTS OF PULMONARY DISEASE

PAUL C. SAMSON, M.D., F.A.C.S., Oakland, *Chairman.*

Monday, 8:30—11:30 a.m., Nob Hill Theater, Fairmont Hotel

THOMAS H. BURFORD, M.D., F.A.C.S., St. Louis, *Presiding.*

Immediate Care of the Injured Thorax. THOMAS H. BURFORD, M.D., F.A.C.S., St. Louis.

Indications for Early Thoracotomy in Thoracic Wounds and Injuries.

The Diagnosis and Treatment of Thoracoabdominal Wounds and Injuries. LAURENCE M. SHEFTS, M.D., F.A.C.S., San Antonio.

Indications for Delayed Surgery in Thoracic Injuries. HIRAM LANGSTON, M.D., F.A.C.S., Chicago.

Panel Discussion: Thoracic Trauma.

THOMAS H. BURFORD, M.D., F.A.C.S., St. Louis, *Moderator.*

Collaborators: LAURENCE M. SHEFTS, M.D., F.A.C.S., San Antonio; HIRAM LANGSTON, M.D., F.A.C.S., Chicago.

Tuesday, 8:30—11:30 a.m., Nob Hill Theater, Fairmont Hotel

H. BRODIE STEPHENS, M.D., San Francisco, *Presiding.*

The ABC's of Pulmonary Function Tests for Thoracic Surgeons. JAMES KIERAN, M.D., Oakland, California.

Symposium: The Surgical Aspects of Acute and Chronic Nontuberculous Affections of the Lung Including Emphysema.

Discussion Leader: H. BRODIE STEPHENS, M.D., San Francisco.

Participants: JAMES KIERAN, M.D., Oakland, California; ROBERT R. SHAW, M.D., F.A.C.S., Dallas; DAVID J. DUGAN, M.D., F.A.C.S., Oakland.

Wednesday, 8:30—11:30 a.m., Nob Hill Theater, Fairmont Hotel

JOHN C. JONES, M.D., F.A.C.S., Los Angeles, *Presiding*.

Tumors of the Mediastinum and Thoracic Wall. LYMAN A. BREWER, III, M.D., F.A.C.S., Los Angeles.

The Pulmonary "Coin" Lesion and What to do About It. CLIFFORD F. STOREY, M.D., F.A.C.S., San Diego.

Adenoma and Other So-Called Benign Tumors of the Bronchus. NORMAN J. WILSON, M.D., F.A.C.S., Boston.

Essentials in the Surgical Treatment of Bronchogenic Carcinoma. JOHN C. JONES, M.D., F.A.C.S., Los Angeles.

The Treatment of Inoperable and Incompletely Resected Carcinoma. ALTON OCHSNER, M.D., F.A.C.S., New Orleans.

Panel Discussion: Thoracic Tumors.

Moderator: JOHN C. JONES, M.D., F.A.C.S., Los Angeles.

Collaborators: LYMAN A. BREWER, III, M.D., F.A.C.S., Los Angeles; CLIFFORD F. STOREY, M.D., F.A.C.S., San Diego; NORMAN J. WILSON, M.D., F.A.C.S., Boston; ALTON OCHSNER, M.D., F.A.C.S., New Orleans.

Thursday, 8:30—11:30 a.m., Nob Hill Theater, Fairmont Hotel

Symposium: Present Day Medical and Surgical Therapies in Pulmonary Tuberculosis.

Discussion Leader: WILLIAM M. TUTTLE, M.D., F.A.C.S., Detroit.

Participants: CORWIN HINSHAW, M.D., F.A.C.P., San Francisco; JOSEPH W. GALE, M.D., F.A.C.S., Madison; HOWARD T. BARKLEY, M.D., F.A.C.S., Houston; NORMAN J. WILSON, M.D., F.A.C.S., Boston.

Symposium on Graduate Training in Surgery and the Surgical Specialties

Thursday, 1:30—3:00 p.m., Fairmont Hotel

FREDERICK A. COLLER, M.D., F.A.C.S., Ann Arbor, *Chairman*.

Basic Science Courses in Graduate Education. ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus.

General Surgery Programs for Specialty Resident. JOEL W. BAKER, M.D., F.A.C.S., Seattle.

Effect of Military Demands on Training Programs. FRANK B. BERRY, M.D., F.A.C.S., Washington, D. C.

Motion Picture Symposium: New or Unusual Problems in Surgery

Wednesday, 7:15—10:00 p.m., Peacock Court, Mark Hopkins Hotel

RUDOLF J. NOER, M.D., F.A.C.S., Louisville, Kentucky, *Presiding*.

Cervical Rib with Subclavian Artery Thrombosis. CLARENCE J. SCHEIN, M.D., F.A.C.S., New York.

Giant Diverticulum of Duodenum. ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus, Ohio.

Adrenal Hyperplasia in Children. EDWIN H. ELLISON, M.D., F.A.C.S., Columbus, Ohio.

Rupture of Bronchus. JAMES D. HARDY, M.D., F.A.C.S., Jackson; Professor of Surgery and Chairman, Department of Surgery, University of Mississippi School of Medicine; Surgeon-in-Chief, University Hospital.

Pulmonary Arteriovenous Fistula. LAWRENCE H. STRUG, M.D., F.A.C.S., New Orleans.

Hamartoma of Spleen. GEORGE A. OLANDER, M.D., F.A.C.S., Highland Park, Illinois.

Duodenal Obstruction. HUGH B. LYNN, M.D., Louisville, Kentucky.

Resection of Abdominal Aorta with Celiac Axis of Renal Arteries and Graft. MICHAEL E. DEBAKEY, M.D., F.A.C.S., Houston; Professor and Chairman, Department of Surgery, Baylor University College of Medicine.

Coarctation with Aneurysm in Pregnancy. Resection and Graft (Hypothermia). ORMAND C. JULIAN, M.D., F.A.C.S., Chicago.

Closure of Congenital Interauricular Septal Defect by the "Circumclusion" Technique of Sondergaard. PAUL T. DECAMP, M.D., F.A.C.S., New Orleans, Louisiana.

Color Television

Monday through Friday, 9:00 a.m.—12 noon; 2:00—5 p.m., Larkin Hall, Civic Auditorium

Moderators, panels, and time will appear in official Clinical Congress handbook.

Ciné Clinics

Tuesday through Friday, 8:30—12:30 p.m., Arena, Civic Auditorium

Operations, surgeons, and time will appear in official Clinical Congress handbook.

Forum on Fundamental Surgical Problems

Monday, 8:30 a.m.–12:00 noon, Terrace Room, Fairmont Hotel

WATER, ELECTROLYTES, AND RELATED PROBLEMS

The Effect of Deno-Testosterone Derivatives on Nitrogren Balance and Body Weight in Postoperative Patients. WILLIAM E. ABBOTT, STANLEY LEVEY, HARVEY KRIEGER, JERREL W. BENSON, and C. JACKSON RAYBURN, Cleveland, Ohio.

Effect of Hormones on the Metabolism of Surgical Patients. HELENA GILDER, EDWARD A. FREE, DONALD L. WEEKS, JR., and JOHN M. BEAL, New York, New York.

The Effect in Humans of Alterations of Extracellular *p*H on the Serum Potassium Concentration. BELDING H. SCRIBNER, MARIO VILLAMIL, BEN T. UYENO, and JAMES M. BURNELL, Seattle, Washington.

The Effect of Induced Respiratory Acidosis and Alkalosis on Serum Potassium Levels of the Anesthetized Human Patient in the Presence of Decreased Renal Function. HRANT H. STONE, DAVID SELIGSON, HARRY BURROS, and PAUL NEMIR, JR., Philadelphia, Pennsylvania.

Body Fluid Metabolism—II, the Relative Efficacy in Man of $NaHCO_3$ and Na Lactate as Alkalizing Compounds, and of NH_4Cl and HCl as Acidifying Compounds. JAMES D. HARDY, Jackson, Mississippi. Technical assistance of VIRGINIA WARD.

Studies on Enterostomy Management in Infants. WILLIAM R. RICHARDSON and ROBERT E. GROSS, Boston, Massachusetts.

Electrolyte Balances in Newborn Infants Following Major Surgical Procedures. ELEANOR COLLE and ELSA PAULSEN, Minneapolis, Minnesota.

Adrenal Corticoid Output in Surgical Patients with Obstructive Jaundice. JOHN H. SCHNEEWIND and JOHN B. FULLER, Chicago, Illinois.

Changes in Sodium Metabolism Following Portacaval Shunts in Patients with Cirrhosis and Ascites. KEITH REEMTSMA, ROBERT E. CARLSON, DAVID V. HABIF, and HAROLD G. BARKER, New York, New York.

Enterodialysis; an Approach to the Problem of Renal Substitution. PAUL R. SCHLOERB, Kansas City, Kansas.

Observations on the Osmolar Concentration Changes of Serum and Urine in Response to Variable Concentrations of Intravenous Sodium, Glucose, and Water in Normal Subjects. JAMES O. ROBINSON, JOHN R. ALGER, and ROBERT E. L. BERRY, Ann Arbor, Michigan.

Effects of Ascites Formation on Response of Ringer's-Infused Unanesthetized Dogs to Rapid Injection of Water and Sodium Loads. J. STAMLER, L. DREIFUS, EMANUEL MARCUS, J. T. SHERIDAN, ELLSWORTH E. HASBROUCK, and S. WONG with the assistance of A. ELLIS, C. KAKITA, C. JONES, and K. MAIER, Chicago, Illinois.

The Treatment of Experimental Cerebral Edema by Intravenous Hypertonic Solutions. RAYMOND CLASEN, SYLVIA PANDOLFI, FELIX MARTIN, and C. BRUCE TAYLOR, Chicago, Illinois.

Monday, 8:30 a.m.–12:00 noon, Gold Room, Fairmont Hotel

GASTRIC PHYSIOLOGY AND ALLIED PROBLEMS

The Significance of Innervation in Function of the Gastric Antrum. H. A. OBERHELMAN, JR., S. P. RIGLER, and LESTER R. DRAGSTEDT, Chicago, Illinois.

Inhibition of the Intestinal Phase of Gastric Acid Production by Antral Inhibitor Factor. B. MARGOLUS and R. C. HARRISON, Edmonton, Alberta.

The Effect of Cortisone on Histamine Stimulation of Gastric Secretion in the Adrenalectomized Dog. B. SIGEL, DONALD R. COOPER, JAMES G. BASSETT, and L. KRAEER FERGUSON, Philadelphia, Pennsylvania.

Increase in Digestive Action of Human Gastric Juice Following Major Surgical Procedures. JOHN F. PERRY, JR., EARL G. YONEHIRO, PO MYET YA, and HARLAN D. ROOT, Minneapolis, Minnesota.

The Secretory Effect of Gastric Transection. CLIFTON F. MOUNTAIN, J. H. LANDOR, J. D. MCCARTHY, PAUL V. HARPER, and LESTER R. DRAGSTEDT, Chicago, Illinois.

Effects of Total Pancreatectomy on Gastric Secretion. J. BARCENA, J. L. BRAVO, C. M. BAUGH, CLIFTON F. MOUNTAIN, and LESTER R. DRAGSTEDT, Chicago, Illinois.

Pepsin in Gastric Physiology: Effect of Ulcer Diathesis, ACTH, Histamine, Anesthesia-Operation, Banthine, Pilocarpine, Epinephrine, and Sedation upon Blood and Urine Pepsin Levels and upon Gastric Acidity. ALBERT L. MEENA, J. HAROLD CONN, HANS NAUMANN, and JAMES D. HARDY, Jackson, Mississippi.

The Effect of Anastomosis of the Pancreatic Duct to the Gastric Antrum on the Production of Experimental Peptic Ulcer. JOHN R. BROOKS, Boston, Massachusetts.

An Evaluation in the Dog of Cardiac Sphincter Substitution by Interposed Colon in the Presence of Vagotomy and Pyloroplasty. GEORGE I. THOMAS, and K. ALVIN MERENDINO, Seattle, Washington.

Heidenhain Pouch Secretory Response to Gastrojejunostomy as Affected by Position on Stomach and Variation in Stomal Diameter. JOHN K. STEVENSON, JOHN E. JESSEPH, THOMAS W. JONES, and HENRY N. HARKINS, Seattle, Washington.

Utilization of the Ileocolic Valve as a Substitute for the "Cardio-Esophageal Sphincter." JOHN S. NAJARIAN, CHAUNCEY D. BUSTER, DWIGHT H. MURRAY, JR., and ORVILLE F. GRIMES, San Francisco, California.

The Prevention of Esophagitis After Esophagogastrostomy in Dogs by an Interposed Pedicled Pylorus. PAUL MCGANNON and STANLEY R. FRIESEN, Kansas City, Kansas.

Study on the Site and Mechanism of Gastrin Release. C. M. BAUGH, J. L. BRAVO, J. BARCENA, and LESTER R. DRAGSTEDT, Chicago, Illinois.

Monday, 1:30–5:00 p.m., Venetian Room, Fairmont Hotel

CORONARY DISEASE, VASCULAR INSUFFICIENCY, AND PULMONARY STENOSIS

Measurement of the Electrical Resistance of the Human Heart. CHARLES K. KIRBY, JOSEPH ENGELBERG, and JULIAN JOHNSON, Philadelphia, Pennsylvania.

The Preoperative Evaluation of Patients with Aortic and Mitral Valvular Disease by Left Heart Catheterization. WILLIAM S. BLAKEMORE, T. S. SCHNABEL, JR., P. T. KUO, and H. CONN, Philadelphia, Pennsylvania.

Evaluation of Aortic Insufficiency by Angiography. DAN W. ELLIOTT, WILLIAM MOLNAR, JOSEPH M. RYAN, and KARL P. KLASSEN, Columbus, Ohio.

Chronic Mitral Insufficiency in Dogs. SAM J. KUYKENDALL, F. HENRY ELLIS, JR., JOHN H. GRINDLAY, and EARL H. WOOD, Rochester, Minnesota.

Retrograde Perfusion of the Coronary Veins for Open Operative Procedures upon the Aortic Valve or the Coronary Arteries. VINCENT L. GOTT, JUAN L. GONZALAS, RICHARD L. VARCO, and C. WALTON LILLEHEI, Minneapolis, Minnesota.

Prosthetic Subcoronary Aortic Valves. W. G. MALETTE, W. B. SUMMERS, and BEN EISEMAN, Denver, Colorado.

Spring Valve Prosthesis for the Correction of Valvular Insufficiency. JAMES H. WIBLE, LYLE F. JACOBSON, PRESCOTT JORDAN, JR., and CHARLES G. JOHNSTON, Detroit, Michigan.

Pulmonary Artery Changes in Mitral Stenosis; an Experimental Study. DONALD W. HANNON, ALLEN FERRIN, FRANCIS HADDY, JOSEPH L. SPRAFKA, and IVAN D. BARONOFSKY, Minneapolis, Minnesota.

The Use of Alcohol in the Treatment of the Postvalvulotomy Hyponatremic Syndrome. GEORGE J. D'ANGELO, H. V. MURDAUGH, WILL C. SEALY, and IVAN W. BROWN, JR., Durham, North Carolina.

Surgical Treatment for Aneurysms of the Aortic Sinuses with Aorticoatrial Fistula; Experimental and Clinical Study. JOHN L. SAWYERS, JESSE E. ADAMS, and H. WILLIAM SCOTT, JR., Nashville, Tennessee.

The Effects of Gradual Occlusion of the Coronary Arterial Circulation in Dogs and Pigs. CHARLES G. NEUMANN, ALBERT B. LOWENFELS, WILLIAM H. WADE, JERROLD VON WEDEL, JERE W. LORD, JR., and J. WILLIAM HINTON, New York, New York.

Experimental Closure of Ruptured Sinus of Valsalva Aneurysms. R. ROBINSON BAKER, HANS ERIK HANSON, and ANDREW G. MORROW, Bethesda, Maryland.

A Study of the Effects of Large Right Ventriculotomies in Dogs. WILLIAM H. MULLER, JR., WILLIAM H. MARSH, J. FRANCIS DAMMANN, JR., and W. DEAN WARREN, Charlottesville, Virginia.

Monday, 1:30–5:00 p.m., Gold Room, Fairmont Hotel

PULMONARY PROBLEMS, ANESTHESIA

The Effect of Compression of the Lung on Pulmonary Ventilation. THOMAS F. NEALON, JR., JOYCE E. PRICE, and JOHN H. GIBBON, JR., Philadelphia, Pennsylvania.

The Effect on Respiratory Dynamics of Treatment of Chronic Anemia by Blood Transfusion. KENNETH ADWAN and BEN J. WILSON, Dallas, Texas.

Human Measurements Involved in Tracheobronchial Resection, Reconstruction, and Prosthetic Replacement. JOHN E. JESSEPH, JOHN K. STEVENSON, HENRY N. HARKINS, and K. ALVIN MERENDINO, Seattle, Washington.

Cardiopulmonary Reserve 5 to 15 Years Following 50 Per Cent or More Reduction of Lung Volume. ROBERT W. HARRISON, WALTER BUEHLER, RICHARD G. THOMPSON, EDWIN T. LONG, RALPH CARLSON, BERNARD CHARBON, and WILLIAM E. ADAMS, Chicago, Illinois.

A Study of the Bronchial Flow in the Dog. DAVID STATE and PETER F. SALISBURY, Los Angeles, California.

Dynamics of Pleural Effusions. ROY H. CLAUSS, HAROLD G. BARKER, and HAGOP YACOUBIAN, New York, New York.

An Improved Electronic Respirator. CHARLES E. TURBAK, ROBERT B. BENJAMIN, LOUIS M. LEVY, and F. JOHN LEWIS, Minneapolis, Minnesota.

The Effect of Anesthesia on Blood Volume and Osmotic Pressure. WILLIAM R. DRUCKER, ROBERT STULTS, CHRISTINE COSTLEY, J. DOCKERY, and WILLIAM D HOLDEN, Cleveland, Ohio.

The Effect of Ether Anesthesia on Pyruvate Metabolism. WILLIAM R. DRUCKER, CHRISTINE COSTLEY, ROBERT STULTS, MAX MILLER, JAMES W. CRAIG, and HIRAM WOODWARD, Cleveland, Ohio.

Anesthesia Research—I, Comparison of "Usual" vs. Mechanical Inflation. JAMES D. HARDY, JOHN O. DAMPEER, JR., and GLACE E. BITTENBENDER, Jackson, Mississippi.

Pulmonary Vascular Change Induced by Experimentally Produced Pulmonary Arterial Hypertension. J. FRANCIS DAMMANN, JR., JAMES P. BAKER, and WILLIAM H. MULLER, JR., Charlottesville, Virginia.

The Mechanism of Circulatory Failure in Acute Anoxia. IBRAHIM K. DAGHER and GEORGE H. A. CLOWES, JR., Cleveland, Ohio.

Monday, 1:30–5:00 p.m., Terrace Room, Fairmont Hotel

PANCREAS, BILIARY PROBLEMS, AND INTESTINAL PROBLEMS

Diagnostic Value of Urinary Lipase. ALLAN D. CALLOW, MARTIN M. NOTHMAN, and JOSEPH H. PRATT (Deceased), Boston, Massachusetts.

Mortality in Experimental Acute Pancreatitis. I. H. SOKOLIC and ALEXANDER W. ULIN, Philadelphia, Pennsylvania.

The Role of Propylthiouracil in Pancreatitis. L. CORSAN REID, THOMAS W. CHALLIS, and J. WILLIAM HINTON, New York, New York.

Nitrogen Balance in Animals with Biliary Fistula. LOREN J. HUMPHREY, Chicago, Illinois.

The Role of the Shwartzman Reaction in the Pathogenesis of Inflammatory Lesions of the Biliary Tract. STUART ROBERTS, Chicago, Illinois.

Comparative Fat and Fatty Acid Studies in Intestinal Malabsorption States. JAMES R. MALM, KEITH REEMTSMA, and HAROLD G. BARKER, New York, New York.

Efficiency of Utilization of Oral and Parenteral Foodstuffs Studied by Carbon Dioxide Production. JOHN M. KINNEY, WILLIAM G. HAMMOND, W. BANKS ANDERSON, JR., and ELLIOTT V. MILLER, Boston, Massachusetts.

Thiry Fistula Studies in Strangulation Obstruction. GEORGE J. WERNETTE and ISIDORE COHN, JR., New Orleans, Louisiana.

Measurement of Sequestration of Red Cells Mass in Strangulating Intestinal Obstruction Utilizing Radioactive Cr^{51}. PO MYAT YA, JOHN F. PERRY, JR., and MAUNG SOE THEIN, Minneapolis, Minnesota.

Osmotic Diuresis as Treatment in Severe Hyponatremia. WILLIAM G. HAMMOND, RODMAN D. CARTER, JOHN M. DAVIS, and FRANCIS D. MOORE, Boston, Massachusetts.

The Influence of Growth Hormone on Protein Metabolism. MELVIN S. SCHWARTZ, Fort Sam Houston, Texas and JOHN F. PRUDDEN, New York, New York.

Tuesday, 8:30 a.m.–12:00 noon, Terrace Room, Fairmont Hotel

TUMORS AND TRANSPLANTATION

The Experimental Design of Studies to Evaluate the Chemotherapy of Solid Tumors as Demonstrated by the Use of Triethylenethiophosphoramide. GEORGE E. MOORE, TOMPKINS G. WATSON, KUMAO SAKO, and ARTURO BELTRAN, Buffalo, New York.

Localization of P^{32} as a Diagnostic Aid in Gastrointestinal Neoplasma. D. SHAHON, J. BRADLEY AUST, and HARLAN ROOT, Minneapolis, Minnesota.

Air-Borne Metastasis in the Lung; an Experimental Study in Mice. TOM D. NORMAN and ROBERT D. MCBROOM, Jackson, Mississippi.

Treatment of Experimental Lymphoid Tumor with Heterologous Antiserum and Immune Lymphocytes. J. T. GRACE, FRANK GOLLAN, and ROBERT I. CARLSON, Nashville, Tennessee.

The Effect of Cancer Inhibitor Drugs on the "Take" of Walker Carcinosarcoma 256 in Rats. ERNESTO P. CRUZ, GERALD O. MCDONALD, and WARREN H. COLE, Chicago, Illinois.

Tumor Homotransplantation in Inbred Mice in the Newborn Period. J. BRADLEY AUST, C. MARTINEZ, J. J. BITTNER, and R. A. GOOD, Minneapolis, Minnesota.

Immunity in Mice to Strain Specific Tumor Transplantation Following Growth and Removal of the Same Tumor. C. MARTINEZ, J. BRADLEY AUST, and J. J. BITTNER, Minneapolis, Minnesota.

Further Observation on the Lymphatic Pick-up of Radioactive Silver-coated Gold Administered Intrathoracically to Dogs. R. A. MATUSKA, P. F. HAHN, ROBERT I. CARLSON, S. H. AUERBACH, and G. R. MENEELY Nashville, Tennessee.

Hormonal Factors Affecting Growth of Experimental Secondary Bone Tumors. T. B. SINGH, STANLEY C. SKORYNA, A. C. RITCHIE, and DONALD R. WEBSTER, Montreal, Quebec.

Combined Therapy (Bilateral Adrenalectomy and Radioactive Phosphorus) for Carcinoma of the Breast with Widespread Metastases to Bone. HARVEY KRIEGER, WILLIAM E. ABBOTT, WILLIAM D. HOLDEN, FREDERICK J. BONTE, and HYMER L. FRIEDELL, Cleveland, Ohio.

Progression of Lymphatic Metastases in Carcinoma of Breast. COLIN G. THOMAS, JR., Chapel Hill, North Carolina.

Islet Cell Transplantation. HENRY SWAN and WILLIAM R. RUNDLES, Denver, Colorado.

Tuesday, 8:30 a.m.–12:00 noon, Gold Room, Fairmont Hotel

BLOOD, CORTICOIDS, AND SHOCK

The Significance of the Ratio Free/Conjugated 17, 21-Dihydroxy Steroids of Blood. M. DON TURNER and JAMES D. HARDY, Jackson, Mississippi. Technical assistance of THELMA CARTER and VIRGINIA WARD.

The Distribution of Corticosteroids in the Plasma and Red Cells of Surgical Patients. ARNOLD MITTELMAN and HAROLD G. BARKER, New York, New York.

The Metabolic Changes Following Hemorrhage Without Shock. FRANCIS D. MOORE, RODMAN D. CARTER, LEONARD J. TRIEDMAN, and WILLIAM G. HAMMOND, Boston, Massachusetts.

A Simplified Method for Blood Volume Determinations Using Radioactive Isotopes. W. A. SPENCER, J. R. THISTLEWAITE, and S. N. ALBERT, Washington, D. C.

General and Differential Hypothermia (Intraperitoneal) in Prevention of Ischemic Shock and Paraplegia Following Temporary Occlusion of the Thoracic Aorta. W. M. PARKINS, MAX BEN, and HARRY M. VARS, Philadelphia, Pennsylvania.

Prevention of Irreversible Hemorrhagic Shock in Dogs by Controlled Cross-Perfusion of the Superior Mesenteric Artery. RICHARD C. LILLEHEI, Washington, D. C.

Tolerance of Dogs Resuscitated with Dextran to Subsequent Surgical Stress. GEOFFREY SLANEY, Chicago, Illinois.

The Phenomenon of Irreversibility in Hemorrhagic Shock. JOSEPH G. STRAWITZ and HELEN HIFT, Madison, Wisconsin.

The Relationship of Blood Volume to Exchangeable Potassium; an Inquiry into the Concept of "Chronic Shock." H. VICTOR PARKER, JAMES D. MCMURREY, and FRANCIS D. MOORE, Boston, Massachusetts.

Traumatic Renal Failure. A Possible Etiology. JERRY A. STIRMAN and BEN J. WILSON, Dallas, Texas.

Elevation of Blood Ammonium in Hemorrhagic Shock. J. SHELTON HORSLEY, III, JEROME J. DECOSSE, MARGARET HOOD, NAOMI SAGER, KATHLEEN E. ROBERTS, and HENRY T. RANDALL, New York.

Depressed Response to Intravenous Sympathicomimetic Agents in Humans During Acidosis. GILBERT S. CAMPBELL, DUDLEY B. HOULE, MAX H. WEIL, and E. B. BROWN, JR., Minneapolis, Minnesota.

A Continuously Recording Quantitative Estimation of Circulatory Changes in the Liver and Small Intestine of the Dog During Shock Induced by Endotoxin. LLOYD D. MACLEAN, MAX H. WEIL, WESLEY W. SPINK, and MAURICE B. VISSCHER, Minneapolis, Minnesota.

Tuesday, 1:30–5:00 p.m., Terrace Room, Fairmont Hotel

BURNS, NITROGEN BALANCE, AND PROTEIN METABOLISM

Development of Histologic Techniques for the Differential Staining of Burned and Normal Tissue. J. RAYMOND HINSHAW and HERMAN E. PEARSE, Rochester, New York.

Determination of Cutaneous Burn Depth in Experimental Animals Using Radioactive Phosphorus. JAMES E. BENNETT, Ann Arbor, Michigan.

Protection Against Contact with Flash Burns. GEORGE D. ZUIDEMA, NEVILLE P. CLARKE, JAMES R. PRINE, and EDWIN W. SALZMAN, Wright-Patterson Air Force Base, Ohio.

Experimental Grafting of a Suspension of Skin Particles. JOHN S. NAJARIAN and HORACE J. MCCORKLE, San Francisco, California.

A Planned Evaluation of Early Excision of More than 25 Per Cent of the Body Surface in Burns. BRUCE G. MACMILLAN, ELINOR PEARSON, and CURTIS P. ARTZ, Fort Sam Houston, Texas.

Effects of Thermal Injury on Metabolic and Insensible Water Loss in the Rat. ZELIG H. LIEBERMAN and JAMES M. LANSCHE, St. Louis, Missouri.

The Evaluation of the Nitrogen Requirements at Various Times Postburn. HARRY S. SOROFF, ELINOR PEARSON, NORRIS L. GREEN, and CURTIS P. ARTZ, Fort Sam Houston, Texas.

Hemoglobinemia in Surgery. J. V. COCKRELL and H. N. NAUMANN, Jackson, Mississippi.

Intracellular and Extracellular Changes of Fluids and Electrolytes in Experimental Uremia. B. F. Rush, JR., KATHLEEN E. ROBERTS, and HENRY T. RANDALL, New York, New York.

Comparative Effectiveness of Intravenous Gelatin, Plasma, Protein Hydrolysate, and Oral Horse Meat as the Sole Source of Nitrogen in Underweight Adult Dogs Maintained on Low Caloric Nonprotein Diets. LOUIS R. HEAD, WALTER EIDBO, WYNN A. SAYMAN, and J. GARROTT ALLEN, Chicago, Illinois.

A Comparison of the Effectiveness of Identical Quantities of Nitrogen Administered Intravenously in the Form of Protein Hydrolysates, Gelatin, and Plasma on the Growth Rate, Weight Gain, and Nitrogen Balance of Littermate Puppies. WYNN A. SAYMAN, LOUIS F. PLZAK, LOUIS R. HEAD, ELLEN CALVARY, JANICE E. PLZAK, NORMAN BALLIN, and J. GARROTT ALLEN, Chicago, Illinois.

Further Studies on the Turnover Rates of Plasma Proteins in Protein Depletion. ROBERT E. MADDEN, Chicago, Illinois.

Acute Depletion of Gamma Globulin in the Dog. GEORGE L. JORDAN, JR., OSCAR CREECH, JR., WILLIAM H. BARNETT, ARIEL BARSELA, and MICHAEL E. DEBAKEY, Houston, Texas.

Tuesday, 1:30–5:00 p.m., Venetian Room, Fairmont Hotel

LIVER AND INTESTINAL PROBLEMS

The Measurement of Blood Flow in the Liver. C. D. BUSTER, KENNETH G. SCOTT, JOHN S. NAJARIAN, DWIGHT H. MURRAY, JR., HAROLD A. HARPER, and HORACE J. MCCORKLE, San Francisco, California.

Effects of Changing Hepatic Blood Flow on 17 Hydroxycorticosteroid Metabolism. EDWIN ENGLERT, JR., RUSSELL M. NELSON, HAROLD BROWN, TALMAGE W. NIELSEN, and SHELLY N. CHOU, Salt Lake City, Utah.

Digestion of Blood in the Genesis of Hepatic Coma. HAROLD F. WELCH, JOSEPH C. PENDER, and JOHN E. KILEY, Albany, New York.

A Comparison of Liver Function Following Eck Fistula and Portacaval Transposition. WILLIAM SILEN, DEAN L. MAWDSLEY, WILLIAM L. WEIRICH, and HAROLD A. HARPER, San Francisco, California.

The Use of a Donor Liver in Experimental Animals with Elevated Blood Ammonium. JAMES J. OTTO, JOSEPH C. PENDER, JAMES H. CLEARY, DAVID SENSENIG, and C. STUART WELCH, Albany, New York.

A Comparison of Arginine and L-Glutamic Acid in the Treatment of Ammonia Toxicity. JOHN S. NAJARIAN, HAROLD A. HARPER, and WILLIAM SILEN, San Francisco, California.

Metabolic Effects of Transposition of the Portal Vein and Inferior Vena Cava. W. B. SUMMERS, W. G. MALETTE, and BEN EISEMAN, Denver, Colorado.

The Production of Experimental Ascites in the Dog With Diabetes Insipidus. JOHN H. LARAGH, JULIUS H. JACOBSON, II, FERDINAND F. MCALLISTER, KARLIS ADAMSONS, JR., STANFORD L. ENGEL, and H. B. VAN DYKE, New York, New York.

Surgical Jaundice; Experimental Evidence Against the "Regurgitation Theory." HORACE D. RITCHIE, JOHN H. GRINDLAY, and JESSE L. BOLLMAN, Rochester, Minnesota.

The Long Term Effect of Sphincterotomy on Common Duct Intraductile Pressure. W. H. BROWN and BEN EISEMAN, Denver, Colorado.

Absorption of Experimental Ascitic Fluid into a Segment of Ileac Mucosa Exposed Within the Peritoneal Cavity. IRVING F. ENQUIST, BERNARD LEVOWITZ, SHELDON ADLER, and ALBERT SCHAFFER, New York, New York.

Observations on the Origin of Congenital Intestinal Atresia. C. N. BARNARD, Minneapolis, Minnesota.

Relative Susceptibility of the Gastrointestinal Tract to Experimental Acute Peptic Ulceration. LOUIS PLZAK, WALTER FRIED, and EDWARD R. WOODWARD, Los Angeles, California.

Tuesday, 1:30–5:00 p.m., Gold Room, Fairmont Hotel

VASCULAR GRAFTS AND CORTICOIDS

Alteration of Healing Responses in Experimental Wounds of Arteries and Other Tissues by Hypercholesterolemia. CARL B. DAVIS, JR., LAVERNE G. NELSON, GEORGE E. COX, and C. BRUCE TAYLOR, Chicago, Illinois.

Experimental Study in the Use of Homologous Aortic Grafts Preserved in Formalin (10 Per Cent) and Alcohol (70 Per Cent). JOHN L. MADDEN and WILLIAM J. MCCANN, New York, New York.

The Use of Frozen Vena Cava Grafts to Aid the Closure of the Bronchial Stump Following Pneumonectomy. ALFONSO TOPETE, J. TRINIDAD PULIDO, IGNACIO OCHOA MARTINEZ, SALVADOR RODRIGUEZ, ROBERTO VASQUEZ PALLARES, and SALVADOR DIAZ GUTIERREZ, Guadalajara, Mexico.

Evaluation of Arterial Homografts Following 6 Years of Implantation in Dogs. EDWARD B. C. KEEFER and FRANK GLENN, New York, New York.

The Various Effects of Anesthesia, Hypothermia, and Renal Ischemia on the Kidney in Patients Having Excisional Therapy of Thoracic Aneurysms. GEORGE C. MORRIS, JR., ARTHUR C. BEALL, JR., MICHAEL E. DEBAKEY, and JOHN H. MOYER, Houston, Texas.

Determination of Myocardial Blood Flow Utilizing Iodinated (I^{131}) Human Serum Albumin. WALTER S. HENLY, OSCAR CREECH, JR., CECIL M. COUVES, MARY C. MORGAN, DON CHAPMAN, and HERBERT C. ALLEN, JR., Houston, Texas.

Experimental and Clinical Resection of Ventricular Aneurysm. CHARLES P. BAILEY and RICHARD A. GILMAN, Philadelphia, Pennsylvania.

The Effect of Streptokinase and Streptodornase on Vascular Healing. SHIVAJI B. BHONSLAY and RALPH A. DETERLING, JR., New York, New York.

Effect of Testosterone or Cortisone Upon Protein Metabolism in Male Rats. ALVIN L. WATNE, Chicago, Illinois.

Steroid Metabolism in Man: Minute Corticoid Output of Left Adrenal. JAMES D. HARDY and M. DON TURNER, Jackson, Mississippi.

Studies on the Effect of Stimulation of the Femoral Nerve on Adrenal 17-Hydroxycorticosteroid Secretion in the Dog. RICHARD H. EGDAHL and JOHN B. RICHARDS, Minneapolis, Minnesota.

Comparison of the Steroid Formation by Incubated Adrenal Slices of Hypertensive Patients and Normotensive Patients. D. Y. COOPER, J. ROBERTS, J. C. TOUCHSTONE, and O. ROSENTHAL, Philadelphia, Pennsylvania.

Wednesday, 8:30 a.m.–12:00 noon, Gold Room, Fairmont Hotel

SHOCK, PROBLEMS IN MASSIVE TRANSFUSION

Circulatory Responses to Intra-Abdominal Manipulation During Surgery. A. G. ROCCO and LEROY D. VANDAM, Boston, Massachusetts.

Blood Volume Fluctuations Determined by CR51 and RISA. J. R. THISTLETHWAITE, W. A. SPENCER, and S. N. ALBERT, Washington, D. C.

Comparison of the Recalcification Time of Whole Blood with the Coagulation Time in Glass as a Measure of Heparin Effect. RICHARD WARREN and JOHN V. BELKO, Boston, Massachusetts.

Endocrine Factors in the Alterations of the Blood Coagulation Mechanism Following Surgery. JOHN A. WILLIAMS and RICHARD WARREN, Boston, Massachusetts.

A New Method for the Continuous or Repeated Determinations of Blood Volume. DONALD B. ROCHLIN, TIMOTHY R. TALBOT, WILLIAM S. BLAKEMORE, ALICE L. CARY, and ROBERT O. GORSON, Philadelphia, Pennsylvania

A Simple Method for Pretransfusion Removal of Potassium from Stored Whole Blood. ROY H. CLAUSS and HILLARY CHOLLET, New York, New York.

Etiology of Sloughs Produced by l-Norepinephrine. JACQUES Y. BERBEN, MILTON F. BRYANT, and JOHN M. HOWARD, Atlanta, Georgia.

Splenic Pulp Manometrics. Preliminary Observations of an Apparently Simple Method for Measuring Portal Venous Pressure. FRANCIS C. JACKSON and JOHN L. HAPPEL, Pittsburgh, Pennsylvania.

The Occurrence of Systemic Hypertension Following Splenorenal and Portacaval Shunts. J. GARROTT ALLEN, WYNN A. SAYMAN, and LOUIS R. HEAD, Chicago, Illinois.

Plasmin Lysis of Experimental Pulmonary Emboli. MICHAEL HUME, WILLIAM W. L. GLENN, PAUL J. ROSENBAUM, and PAUL H. GUILFOIL, New Haven, Connecticut.

Diuresis in Hemorrhagic Hypotension Following Chlorpromazine. EDWIN D. SAVLOV and WILLIAM REGELSON, Buffalo, New York.

The Experimental Production of a Reversible State of Chronic Progressive Edema. JULIUS H. JACOBSON, II, JOHN H. LARAGH, and FERDINAND F. MCALLISTER, New York, New York.

Wednesday, 8:30 a.m.–12:00 noon, Terrace Room, Fairmont Hotel

ANGIOGRAPHY, OSSEOUS VENOGRAPHY, AIR EMBOLISM

A Preliminary Report on a Radioisotope Angiogram. PAUL H. CRANDALL and BENEDICT CASSEN, Los Angeles, California.

Cardiac and Renal Responses in Translumbar Aortography. D. EMERICK SZILAGYI, ROGER F. SMITH, CLAIBOURNE P. SHONNARD, and HERNAN ALVAREZ, Detroit, Michigan.

Hyperhydration: a Method of Decreasing the Nephrotoxic Effects of Urokon as Employed in Aortography. GEORGE C. MORRIS, JR., E. STANLEY CRAWFORD, ARTHUR C. BEALL, and JOHN H. MOYER, Houston, Texas.

The Progression of Experimental Atherosclerosis Following Sympathectomy. THOMAS O. MURPHY, DAVITT A. FELDER, and JOHN J. HAGLIN, Minneapolis, Minnesota.

Vascular Changes and Direct Tissue Effects in Severe Cold Injury. W. L. OGILVY, M. A. ENTIN, and DONALD R. WEBSTER, Montreal, Quebec.

The Circulation of Bone with Particular Reference to the Medulla and Medullography. RUTHERFORD S. GILFILLAN, HOWARD L. STEINBACH, and NICHOLAS L. PETRAKIS, San Francisco, California.

Intraosseous Venography; Its Value to the Surgeon. ROBERT SCHOBINGER VON SCHOWINGEN and FRANZ P. LESSMAN, Buffalo, New York.

A Method for Measurement of Air Introduced Into the Greater Circulation During Open Heart Closure of Atrial Septal Defects. VALLEE L. WILLMAN, E. C. NEVILLE, and C. ROLLINS HANLON, St. Louis, Missouri.

The Effects of Air Embolism in the Systemic Circulation and Its Prevention During Open Cardiac Surgery. ROBERT B. BENJAMIN, CHARLES E. TURBAK, and F. JOHN LEWIS, Minneapolis, Minnesota.

Physiologic and Biochemical Responses to Perfusion Used as an Aid in Open Intracardiac Surgery. RICHARD A. DEWALL, HERBERT E. WARDEN, RICHARD L. VARCO, and C. WALTON LILLEHEI, Minneapolis, Minnesota.

The Relation of Blood Flow and Blood Volume During Extracorporeal Circulation in Man. DAVID E. DONALD and E. A. MOFFITT, Rochester, Minnesota.

Wednesday, 1:30–5:00 p.m., Gold Room, Fairmont Hotel

CARDIAC ARREST, EXTRACORPOREAL CIRCULATION, AND ALLIED PROBLEMS

Further Studies in Induced Cardiac Arrest Using the Agent Acetylcholine. CHARLES K. SERGEANT, THOMAS GEOGHEGAN, and CONRAD R. LAM, Detroit, Michigan.

Hypertonic Glucose in the Resuscitation of the Potassium-Arrested Hypothermic Heart. RICHARD K. MCEVOY and EARLE B. MAHONEY, Rochester, New York.

Metabolic Changes Associated with the Use of the Microbubble Type Pump Oxygenator Under Normothermic and Hypothermic Conditions. SAM E. STEPHENSON, JR., JOHN L. SAWYERS, GEORGE L. HOLCOMB, FRANK GOLLAN, ROLLIN A. DANIEL, JR., and H. WILLIAM SCOTT, JR., Nashville, Tennessee.

The Experimental Production of Arrhythmias by Selective Destruction of the Cardiac Conduction System. ROBERT W. HARRISON, PETER V. MOULDER, PAUL V. HARPER, and WILLIAM E. ADAMS, Chicago, Illinois.

A Simplified Pump Oxygenator with Flow Equal to Normal Cardiac Output. JEROME HAROLD KAY and ROBERT A. GAERTNER, Bethesda, Maryland.

The Ultimate in Vivo Survival of Erythrocytes Which Have Circulated Through a Pump Oxygenator. IVAN W. BROWN, JR., WILMER C. HEWITT, JR., G. S. EADIE, and W. C. SEALY, Durham, North Carolina.

Description and Evaluation of a Rotating Disc Type Reservoir Oxygenator. EARLE B. KAY, ROBERT M. BERNE, YOICHI HIROSE, RICHARD D. JONES, and FREDERICK S. CROSS, Cleveland, Ohio.

Oxygen Requirements During Prolonged Artificial Perfusion with a Blood Oxygenator and Pump. GEORGE H. A. CLOWES, JR., WILLIAM E. NEVILLE, and A. L. HOPKINS, Cleveland, Ohio.

Differential Cardiac Warming During Hypothermia. JAMES R. JUDE, JEAN P. FAUTEUX, and LULU HAROUTUNIAN, Baltimore, Maryland.

Studies in Ventricular Fibrillation in the Pig; Evaluation of an Antifibrillatory Agent Tested by Closed Chest Coronary Artery Occlusion. JOSEPH J. GARAMELLA, LYLE J. HAY, and JAMES G. ANDERSEN, Minneapolis, Minnesota.

Prevention of Ventricular Fibrillation in the Normothermic and Hypothermic Heart—III, the Advantage of Quinidine over Atriocaval Block. SAM E. STEPHENSON, JR. and F. BEACHLEY MAIN, Nashville, Tennessee.

Role of A-V Nodal Blockade in Preventing Ventricular Fibrillation by Faradization. WATTS R. WEBB, Jackson, Mississippi.

Measurements of Coronary Circulation in the Excluded Heart of the Dog During Low Flow Perfusion; the Effects of Fibrillation and Adrenaline. RAYMOND C. READ, JOHN JOHNSON, and C. WALTON LILLEHEI, Minneapolis, Minnesota.

Rapid Detection of Cardiac Arrest with Electrical Resuscitation. K. WILLIAM EDMARK, Seattle, Washington.

Wednesday, 1:30–5:00 p.m., Terrace Room, Fairmont Hotel

NEUROSURGERY

Urea in the Management of Increased Intracranial Pressure. MANUCHER JAVID, PAUL SETTLAGE, and THOMAS MONFORE, Madison, Wisconsin.

A Study on the Effect of Stimulation of the Cerebellum in the Human. NICHOLAS WETZEL and RAY S. SNIDER, Chicago, Illinois.

Cerebral Metabolic Studies of Hypothermia in the Human. JOHN E. ADAMS, VIOLETTE C. SUTHERLAND, HENRY ELLIOTT, ROBERT DUNBAR, and EDWIN J. WYLIE, San Francisco, California.

Intracranial Implantation of Liquid Plastic in the Experimental Animal (Macaque): Possible Clinical Application in Surgical Management of Intracranial Aneurysms. CURWOOD R. HUNTER, FRANK H. MAYFIELD, BERT H. MCBRIDE, and HENRY E. LATTINVILLE, Cincinnati, Ohio.

Suprapineal Recess. O. J. ANDY and J. S. BROWNE, Jackson, Mississippi.

Inhibition of Activity of Cortical Neurones. CHOH-LUH LI, Bethesda, Maryland.

The Effect in Humans of Interruption of the Infundibulum, Followed by the Implantation of a Barrier to Regrowth of the Portal System Connecting the Hypothalamus and the Adenohypophysis. GEORGE EHNI, Houston, Texas.

The Effect of Cortical and Subcortical Brain Lesions upon Gastric Secretion in Dogs with a Vagus Preserved Total Gastric Pouch. HARRY M. RICHTER, JR., RICHARD A. DAVIS, DANIEL RUGE, and NORMAN T. WALTER, Chicago, Illinois.

Studies on the Etiology of Trigeminal Neuralgia—I, Phantom Phenomena of Dental Origin. TEMPLE FAY, Philadelphia, Pennsylvania.

An Evaluation of Hypaque Sodium (Win 8308–3) for Cerebral Angiography. D. W. LINDNER, F. A. MARTIN, JOHN E. WEBSTER, and E. S. GURDJIAN, Detroit, Michigan.

Sterotaxic Direction of Irradiation Beams Through the Human Brain. PETTER A. LINDSTROM, Salt Lake City, Utah.

Wednesday, 1:30–5:00 p.m., Peacock Court, Mark Hopkins Hotel

OBSTETRICS AND GYNECOLOGY

The Proliferative Capacity *in Vitro* of Tissue Explanted From Histologically Benign and Malignant Areas of the Same Uterine Cervix. J. G. MOORE and WARREN BRANDKAMP, Los Angeles, California.

The Clearance of Radioactive Sodium from the Nonpregnant Human Uterus as a Measure of Functional Uterine Blood Flow. MILTON L. MCCALL and JOHN HILDALGO, New Orleans, Louisiana.

Still and Motion Picture Hysterosalpingograms. JOHN A. KERNER, San Francisco, California.

An Experimental Evaluation of Endometrial Biopsy by Suction. JOHN C. BURCH, HORACE T. LAVELY, and ROBERT L. CHALFANT, Nashville, Tennessee.

Closure of the Incompetent Cervix During Pregnancy; Preliminary Report on the Use of Fascia Lata. ROBERT H. BARTER and JOHN L. PARKS, Washington, D. C.

Effect of Position on the Course of the Second Stage of Labor. MICHAEL NEWTON, Jackson, Mississippi.

Uterine Prolapse. BARTLETT H. STONE, Brookline, Massachusetts.

Postmaturity and Fetal Mortality. EDWARD H. BISHOP, Philadelphia.

Wednesday, 1:30–5:00 p.m., Room of the Dons, Mark Hopkins Hotel

ORTHOPEDIC

Low Back Pain in Adolescents. CARROLL B. LARSON, Iowa City, Iowa and J. ROSWELL GALLAGHER, Boston, Massachusetts.

Transversofacet Bone Blocks. J. VERNON LUCK, Los Angeles, California.

The Accumulation of Mast Cells in the Endosteum of Bones of Calcium Deficient Rats. MARSHALL R. URIST, Los Angeles, California, and FRANKLIN C. MCLEAN, Chicago.

The Production of Anaphylactic Arthritis with the Use of Freund's Adjuvants. RICHARD T. ODELL and J. ALBERT KEY (deceased), St. Louis, Missouri.

The Immunology of Skin Transplants. MICHAEL BONFIGLIO, WAYBURN JETER, and WILLIAM OSTRANDER, Iowa City.

The Influence of Vitamin A Induced Epiphyseal Cartilage Abnormalities on Fracture Healing in the Guinea Pig. EDWIN G. BOVILL, JR., San Francisco, California.

A Further Study of Experimental Trauma and Attempts to Stimulate Growth of the Lower Femoral Epiphysis in Rabbits. LEE T. FORD and GOYA CANALES, St. Louis, Missouri.

The Effect of Tension Across the Epiphyseal Plate. WILLIAM S. SMITH, Columbus, Ohio.

Effect of Intramedullary Nailing on the Growth Rate of Immature Femurs of Dogs. FREDERICK L. BEHLING and JOSEPH M. JANES, Rochester, Minnesota.

The Recording of Roentgen Images of Small Bone Specimens Using Xeroradiography. EICHERO ASAI, CRAWFORD J. CAMPBELL, and JOHN ROACH, Albany, New York.

The Development of Circulation in the Necks of Femurs into the Femora of Dogs After Fracture of the Neck. CHARLES J. FRANKEL, DAVID V. STRIDER, and CLARKE POLE, Charlottesville, Virginia.

On the Etiologic Role of Heredity in Fractures. JOSEPH A. BUCKWALTER and ROBERT T. TIDRICK, Iowa City.

Thursday, 8:30 a.m.–12:00 noon, Terrace Room, Fairmont Hotel

NEUROSURGERY

Anatomic and Physiologic Observations of Lissauer's Tract in Animal and Man. R. W. RAND, E. J. PENKA, and W. EUGENE STERN, Los Angeles.

Postcordotomy Studies of Pain Thresholds. ROBERT B. KING, St. Louis, Missouri.

Selective Sacral Neurectomy for Hunner's Ulcer with Neurophysiologic Observations. ROBERT D. WHITFIELD, PAUL W. MYERS, WILLIAM MILNER, and ELDRIDGE CAMPBELL (deceased), Albany, New York.

Decrease of Spasticity by Physiologic Dorsal Root Rhizotomy. GEORGE M. AUSTIN, G. P. MCCOUCH, and F. C. GRANT, Philadelphia, Pennsylvania.

Spontaneous Return of Function Following Surgical Section of Seventh Nerve for Parotid Tumors. HAYES MARTIN and JAMES T. HELSPER, New York, New York.

The Surgical Application of Monomolecular Filters (Millipore) to Bridge Gaps in Peripheral Nerves and to Prevent Neuroma Formation. JAMES B. CAMPBELL and C. ANDREW L. BASSETT, New York, New York.

Diagnosis and Treatment of Diastematomyelia. GEORGE PERRET, Iowa City, Iowa.

The Influence of Differences in Physiopathology upon the Results of Surgery for Syringomyelia. H. THOMAS BALLANTINE, JR., DAVID O. BOWSHER, JOHN A. SCHOLL, and JOHN H. DREW, Boston, Massachusetts.

Thoracic Cordotomy Under Epidural Block Anesthesia. FREDERICK MURTAGH and LEROY W. KRUMPERMAN, Philadelphia, Pennsylvania.

The Treatment of Cervical Disc Disorders by Anterior Approach for Disc Removal and Interbody Fusion. GEORGE W. SMITH and ROBERT A. ROBINSON, Baltimore, Maryland.

Lumbar Discography in Low Back Pain. MILTON F. BROUGHAM and JAMES C. WALKER, Boston, Massachusetts.

Thursday, 8:30 a.m.–12:00 noon, Gold Room, Fairmont Hotel

PLASTIC SURGERY

Modification of Host-Homograft Tissue Interactions in Separated Parabionts. RICHARD H. ANDRESEN, CLARENCE W. MONROE, DOROTHY A. MADDEN, and GEORGE M. HASS, Chicago.

Preliminary Experience with Properdin and Renal Homografts. CHARLES A. HUBAY, LESTER PERSKY, and WILLIAM D. HOLDEN, Cleveland, Ohio.

The Survival of Skin Homografts in the Uremic Patient. NATHAN P. COUCH, JOSEPH E. MURRAY, and GUSTAVE J. DAMMIN, Boston, Massachusetts.

The Effect of the Skin Cycle of the Mouse on the Survival Time of Skin Homografts. IRA M. DUSHOFF and PETER RANDALL, Philadelphia, Pennsylvania.

A Study of Consecutive Skin Homografts in the Dog. LEWIS THOMAS and JOSEPH E. MURRAY, Boston, Massachusetts.

Experiences with the Modification of Individual Tissue Specificity in the Chick. JACK A. CANNON, PAUL I. TERASAKI, and WILLIAM P. LONGMIRE, JR., Los Angeles, California.

Viability Studies of Human Skin Grafts with Tissue Culture Methods. ROBERT M. MCCORMACK, Rochester, New York.

The Differential Staining of the Parotid Gland as a Preliminary to Parotid Surgery. HERBERT J. FORREST, Kansas City, Kansas.

Evaluation of Dacron Suture Material. JOSEPH K. NARAT, JOSEPH P. CANGELOSI, and JOHN V. BELMONTE, Chicago, Illinois.

End Results in 1,000 Facial Wound Closures. HENRY S. PATTON, Oakland, California.

Reconstruction of the Hand Following Median Nerve Palsy. J. EDWARD FLYNN, Boston, Massachusetts.

Flap Grafts From the Trunk to the Upper Extremity. WILLIAM L. WHITE, Pittsburgh, Pennsylvania.

Thursday, 8:30 a.m.–12:00 noon, Polk Hall, Civic Auditorium

UROLOGY

A Study of the Pathologic Anatomy of the Proximal Tubules of the Mouse Produced by Various Nephrotoxins. C. BARBER MUELLER and A. D. MASON, JR., St. Louis, Missouri.

The Radioactive Diodrast Renogram; a New Renal Function Test. CHESTER C. WINTER, Los Angeles, California.

Mechanisms of Hydronephrosis; the Route of Backflow. LESTER PERSKY, FREDERICK J. BONTE, and CHARLES A. HUBAY, Cleveland, Ohio.

The Renal Lymphatics—I, the Effect of Diuretics and Acute Ureteral Obstruction upon the Rate of Flow and Composition of Thoracic Duct Lymph. M. K. MYINT and JOHN J. MURPHY, Philadelphia, Pennsylvania.

The Renal Lymphatics—II, Effect of Increasing Pressure in the Renal Pelvis upon Absorption of Substances of Various Molecular Sizes. JOHN J. MURPHY and M. K. MYINT, Philadelphia, Pennsylvania.

Hydrodynamics of the Intact Human Ureter and Renal Pelvis. WILLIAM H. RATTNER, SIDNEY FINK, and JOHN J. MURPHY, Philadelphia, Pennsylvania.

Variations in the Shape of Peristaltic Action Potentials in the Canine Ureter. HARVEY R. BUTCHER, JR. and WILLIAM W. SLEATOR, JR., St. Louis, Missouri.

Delayed Urinary Flow in Regeneration of Ureteral Muscle. FRANK HINMAN, JR. and RUDOLF O. OPPENHEIMER, San Francisco, California.

A Study of Ureterosigmoidostomy in the Dog with and Without Diverting Colostomy. CHARLES D. CREEVY and JULIAN S. ANSELL, Minneapolis, Minnesota.

Observations on the Operculum Technique for Ureteroenterostomy. JACK LAPIDES, JOHN M. BOBBITT, JAMES W. MORROW, and RUSSELL SCOTT, Ann Arbor, Michigan.

Experimental Study of Regeneration of the Bladder in Dogs. M. K. THAN and CHARLES D. CREEVY, Minneapolis, Minnesota.

Total Mucosal Denudation of the Canine Bladder; Experimental Observations and Clinical Implications. ARNOLD R. SANDERS, CLARENCE J. SCHEIN, and LAZARUS A. ORKIN, New York, New York.

Treatment of the Neurogenic Bladder with Intestinal Grafts. WILLIAM C. SHOEMAKER and DAVID M. LONG, Philadelphia, Pennsylvania.

Investigation of Possible Endogenous Bladder Carcinogens. JEFFREY G. WATSON, Ann Arbor, Michigan.

Distribution and Metabolism Studies of P^{32} Labeled Diethylstilbestrol Diphosphate. LESTER PERSKY, FREDERICK J. BONTE, and JACK S. KROHMER, Cleveland, Ohio.

The Effects of Preoperative Toluidine Blue on Preoperative and Postoperative Fibrinogen Levels in Patients Undergoing Endoscopic Surgery. LOUIS LOMBARDO, TATSUO KIMURA, and JACK KORTZEBOURNE, Los Angeles, California.

The Reliability of the Papanicolaou Technique when Cancer Cells Are Found in the Urine. SAMUEL I. ROLAND and VICTOR F. MARSHALL, New York, New York.

Reversible Hypertension Due to Renal Artery Disease. E. F. POUTASSE, WILLIAM J. ENGEL, and HARRIET DUSTAN, Cleveland, Ohio.

Thursday, 1:30–3:00 p.m., Room 301-305, Civic Auditorium

INFECTIONS AND ABDOMINAL WALL DEFECTS

Some Studies on the Efficacy of Heterologous Tetanus Antitoxin. A. BURGESS VIAL and WALTER S. CALLAHAN, Ann Arbor, Michigan.

The Control of Postoperative Wound Infections Due to Antibiotic-Resistant Staphylococcus Aureus. CHESTER W. HOWE, Boston, Massachusetts.

Evaluation of Peritoneal Lavage in the Treatment of Severe, Diffuse Peritonitis. G. RAYMOND BROWN, JR., Philadelphia, Pennsylvania.

The Use of Nylon Taffeta in Abdominal Wall Defects. ERIC M. NANSON and GAETANO T. FIORICA, Saskatoon, Saskatchewan.

The Repair of Defects in the Diaphragm of Dogs Using Sheets of Ivalon Sponge. IRVING G. PESEK and JOHN L. KEELEY, Chicago, Illinois.

The Handling of Abdominal Wounds Under Mass Casualty Conditions. RUDOLPH A. LIGHT, MICHAEL G. WEIDNER, JR., ROYCE E. DAWSON, DAVID P. HALL, and JOHN L. SAWYERS, Nashville, Tennessee.

Smooth Muscle Regeneration. DAVID S. JONES, GERARD MARTIN, and HAROLD B. HALEY, Chicago, Illinois.

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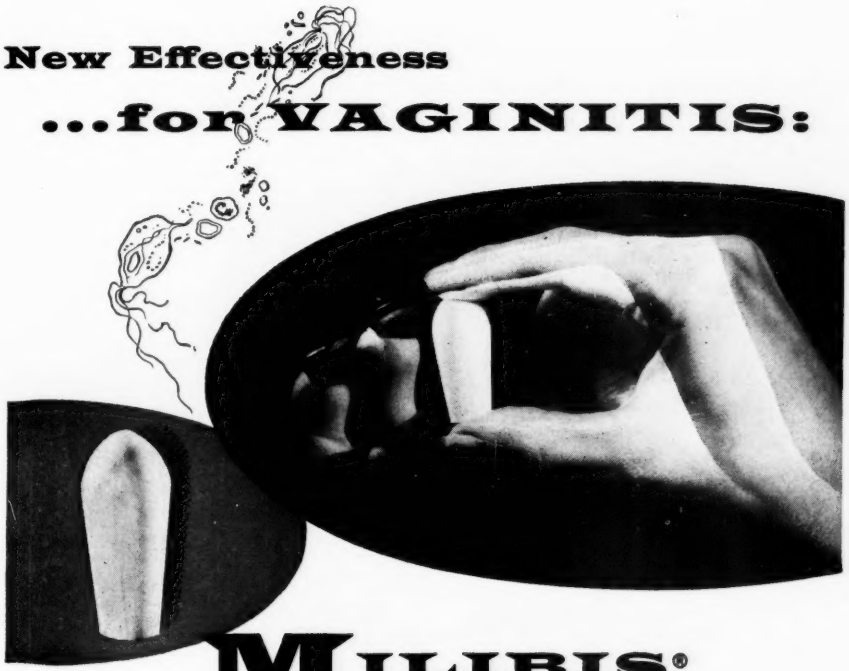

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